TOPAZ SOFTWARE ™

TOPAZ ELECTRONICS ™

PLC Technology ™

Hardware and software suite HSS TOPAZ

IATS and APCS for 35-750 kV substations

remote control systems for 6-20 kV distribution grids

APCS for urban infrastructure

TABLE OF CONTENTS

ABOUT US

PLC Technology was established in 2007. At the root of the company has been a team of experts with extensive experience in automation in power engineering, clearly understanding the particulars of tasks and needs of the market.

The development strategy of the company is the development of a new generation of information acquisition and transmission systems (IATS) and automated process control systems (APCS) for 6-20 kV and 35-500 kV electrical grids based on the principles of scalability, openness and reliability. PLC Technology is a Russian developer and manufacturer that considers strict requirements and peculiarities of Russian power engineering and particulars of operation. Our solutions combine proven technical approach and innovative technologies.

PLC Technology completes turnkey projects due to cycle of production and implementation:
— in-house design office
— production of microprocessor devices
— metrology laboratory
— assembly production
— software development department
— design departments
— promotional departments

"PLC technology" LLC makes comprehensive proposals for 4 main specialized areas:

— **Data collection and transmission systems (DTCS) and automated process control systems (APCS) for electricity networks 35-500 kV**

— **Telemechanics for electricity networks 6-20 kV**

— **Automated control systems for municipal infrastructure facilities**

— **APCS for motor road tunnels and railway tunnels**
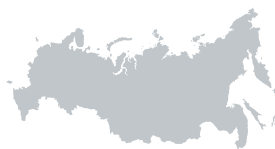
Presence in all federal areas

Presence of international certificate of conformity UCA 61850

UCA International Users Group

Over **200** employees
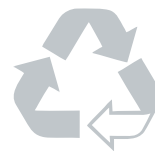
Over **200** product lines

Over **3000** implemented projects

Basing on the requirements and wishes of the Customer, considering the latest world achievements and technologies, "PLC technology" LLC continuously develops and improves the manufactured hardware and software, applies advanced methods of production and quality control, optimizes the methodologies of system installation and adjustment.

"PLC technology" LLC – Russian developer and manufacturer of innovative solutions.

MANUFACTURING OF MICROPROCESSOR UNITS

Robotic PCB production line for the full range of products

Input control of electronic components

PCB processing for protection against environmental influence

Calibration of measuring channels of remote control modules

Full quality control of products, including environmental testing

Permanent minimum balance of the main range of products allowing for short-time deliveries

Typical solutions for the installation of TOPAZ remote control equipment have been developed, agreed and are successfully implemented in cooperation with Russian manufacturers of electrical equipment:

— EZOIS

— Transformer

— Spetsinzhelektro

— "ELEKTROZAVOD"

— "MEL"

— "Samara Transformer"

PARTNERS

Equipment of PLC Technology has been successfully used on the largest electrical infrastructure facilities of JSC Rosseti, including the Federal Grid Company, PJSC "Moscow United Electric Grid Company" and JSC "United Energy Company", JSC "Energocomplex", JSC "Magnitogorsk metallurgical plant", PJSC "NLMK"

World-class companies in the field of energy management that are active in Russia are strategic partners of PLC Technology.

The fact that Schneider Electric, ABB, Siemens chose the solutions of "PLC Technology" for their metal-clad switchgear, and the company has been awarded the status of "federal partner of Schneider Electric in distribution grids market of Russia" is the indicator of the quality and reliability of our products.

IMPLEMENTED PROJECTS

Moscow. Moscow City.

Remote control of a 20 kV distribution grid.

Moscow. Skolkovo.

Dispatching control of a 20 kV grid.

Sochi. Imereti lowland.

Remote control of a 10 kV grid. Organizing a dispatching center with PLC communications.
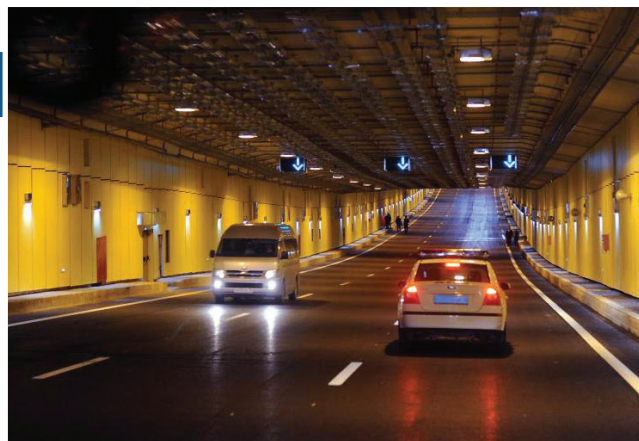
Moscow. Transportation route from Moscow to the MIBC Moscow-City.

APCS for road tunnels, ACS for pedestrian crossings.

— **Over 200 IATS and APCS for 110 and 220 kV power supply centers**

— **Over 1800 distribution substations and transformer substations in 6-20 kV distribution grids**

— **15 APCS for road and railway tunnels**

— **Over 220 APCS for urban infrastructure (pedestrian crossings, external illumination control points)**

PRODUCTS

TOPAZ FAMILY PRODUCTS AND SOLUTIONS

TOPAZ SCADA – APCS for substations and control of distribution grid (ACS DG)

DIGITAL SUBSTATION
Gateways IEC 61850-9-2 to IEC 61850-8-1 MMS

DIGITAL SUBSTATION
AMU IEC 61850-9-2
DMU IEC 61850-8-1 GOOSE

Power system control

Automation for 10-35-750 kV substations

IO modules, bay controllers

TOPAZ RTCM RASP
Fault recording systems for power supply centers

BAY CONTROLLERS
TOPAZ for 35-750 kV substations

TOPAZ IEC DAS
(Data Access Server) for information acquisition and transmission systems (IATS) and APCS

MODULES
IO modules in plastic and metal housing

CONTROLLERS
TOPAZ HVD3 remote terminal units (RTU) for 6-20 kV switchgear cubicles

DATA ACCESS SERVERS TOPAZ IEC DAS

The technology TOPAZ IEC DAS (Data Access Server) is designed specifically for the energy industry and is intended for building remote control systems (IATS) and APCS. TOPAZ software allows setting up multi-platform systems for information acquisition and transmission with the required number of serial (RS-485/422/232, CAN) and Ethernet ports, as well as integrated server solutions for APCS based on freely-programmable controllers under Linux with the required computing resources. As a hardware platform for TOPAZ IEC DAS data acquisition and transmission the fanless industrial controllers of the world's leading manufacturers: MOXA, National Instruments, ADVANTECH, ICP DAS et al.

SUPPORTED PROTOCOLS AND TECHNOLOGIES:

— **IEC 60870-5-101/104**
— **IEC 61850 (MMS, GOOSE)**
— **MODBUS RTU, ASCII, TCP / IP**
— **SPA-BUS (RPA ABB, BRESLER ET AL.)**
— **IEC 60870-5-103 (RPA ALSTOM, SIEMENS, THE SCREEN AND THE DR.)**
— **PRP (PARALLEL REDUNDANCY PROTOCOL) AND HSR (HIGH AVAILABILITY SEAMLESS REDUNDANCY) - PARALLEL AND RING REDUNDANCY NETWORK**
— **IP AND SQL CLUSTERS**
— **BGP (BORDER GATEWAY PROTOCOL) AND OSPF (OPEN SHORTEST PATH FIRST) - DYNAMIC ROUTING**
— **SNTP (SIMPLE NETWORK TIME PROTOCOL) - GPS / GLONASS TIME SYNCHRONIZATION**
— **SNMP (SIMPLE NETWORK MANAGEMENT PROTOCOL) - MANAGEMENT AND CONTROL OF DEVICES AND APPLICATIONS IN THE NETWORK**
— **OPC (OLE FOR PROCESS CONTROL)**
— **WEB DIAGNOSTICS AND PARAMETERIZATION, INCLUDING THROUGH TABLET COMPUTERS AND SMARTPHONES USING A COMPACT USB-WIFI ROUTER.**

OPTIONS OF HARDWARE PLATFORM FOR TOPAZ IEC DAS

— ARM Cortex-A8 up to 1000 MHz
— 512 MB RAM (DDR3)
— 2x Ethernet, 10/100/1000
— 4 RS-485
— USB 2.0 MicroUSB
— 1 x CompactFlash slot
— Operating temperature -40 ° ~ 70 ° C

MX 240 E2R4

MX 681

MX 683

MX 820

Card Type	Additional Features
TOPAZ – GSM	Cellular Modem
TOPAZ R2-DIO8-GPRS	2x Ethernet, 2 x RS485, 8 DI / DO, Cellular modem
TOPAZ – E2R4	2x Ethernet, 4x RS485
TOPAZ – E2R4 Fo	2x Ethernet FO, 4 x RS485
TOPAZ – E4	4 Ethernet
TOPAZ – (1 ... 4) Fo	4 Ethernet FO
TOPAZ – R6	6xRS485

MX 681
— Intel Celeron 1 GHz
— RAM up to 1 GB
— 6xFast Ethernet, RJ45 4hRS-232, 8x RS-485
— 2xUSB 2.0 Host, 1xSATA, 2hRS
— 1xSD Card slot
— Operating temperature -40 ° ~ 70 ° C
— 2 power supply ports

MX 683
— Intel Atom 1.66 GHz
— RAM up to 2 GB
— 6x Gigabit Ethernet, RJ45
— 2x RS-232
— 4xUSB 2.0 Host, 2x SATA, 2x PC1
— 1xCompactFlash slot
— Operating temperature -40 ° ~ 70 ° C
— 2 power supply ports
— 2 slots for interface modules
— 8x DI / DO

MX 820
— Intel Core 2 Duo 2.5 GHz
— RAM up to 16 GB
— 4x Gigabit Ethernet, RJ45
— 2x RS-232
— 6x USB 2.0 Host, 5x PCI RAID, 4x SATA
— 1xCompactFlash slot
— Operating temperature -40 ° ~ 85 ° C
— 2 power supply ports
— 4 slots for interface modules
— 4x DI / DO

TECHNICAL SPECIFICATIONS OF TOPAZ MULTIFUNCTIONAL MICROPROCESSOR UNITS

ELECTROMAGNETIC COMPATIBILITY

Parameter	Russian standard	international standard	test level
Immunity to industrial frequency magnetic field	GOST R 50648,	IEC 61000-4-8	Level 4, Class A
Immunity to impulse magnetic field (IMP)	GOST R50649	IEC 100-4-9	Level 4
Immunity to electrostatic discharge	GOST R 51317.4.2	6 IEC 1000-4-2	Level 3
mmunity to radio-frequency electromagnetic field	GOST R 51317.4.3	6 IEC 1000-4-3	Level 3
Immunity to fast transients	GOST R 51317.4.4	6 IEC 1000-4-4	Level 4
Immunity to high energy microsecond pulse interferences	GOST R 51317.4.5	6 IEC 1000-4-5	Level 4
YImmunity to conducted interference in the frequency range 150 kHz – 80 MHz	GOST R 51317.4.6	6 IEC 1000-4-6	Level 3
Immunity to failures and interruptions in power supply voltage	GOST R 51317.4.11	IEC 6 1000-4-11	Level 4
Immunity to damped oscillatory waves	GOST R51317.4.12	IEC6 1000-4-12	Single - Stage 4 Repeating - level 3
Immunity to conducted interference in the frequency range 0 to 150 kHz	GOST R 51317.4.16	IEC 6 1000-4-16	Level 4
Immunity to pulsation of DC supply voltage	GOST R 51317.4.17	IEC 6 1000-4-17	Level 3
Radio interference in the frequency range 0.15-30 MHz	GOST R 51318.22	CISPR 22:2006	Class A
Radio interference in the frequency range 30-1000 MHz	GOST R 51318.11	CISPR 11:2004	Class A

USE AND STORAGE

Parameter	Russian standard	European standard	test level
Operating temperature	GOST R IEC 60870-2-2	IEC 60870-2-2	Class C3 – 40+ 70 ºC
Transportation and storage temperature	GOST R IEC 60870-2-2	IEC 60870-2-2	Class Ct2 – 40+ 70 ºC
Protection against water and dust ingress	GOST 14254	IEC 60529	IP20
Humidity	GOST R IEC 60870-2-2	IEC 60870-2-2	10–100 % at a temperature 30 °C and lower
Vibration	GOST R IEC 60870-2-2	IEC 60870-2-2	Class Cm. Acceleration 300 m/s2 during 11 ms

Remote signaling (RS) — control of discrete parameters (position of switching devices, control keys, status of control power equipment and protective devices).Selection of the level and type of feeding current (~ / =) is performed by software. Function "burning of contacts" is implemented for remote signaling. For reliable operation of remote signaling channels in conditions of strong electromagnetic interference, the microprocessor module continuously performs digital processing (filtering and integration) for each discrete input signal. The modules incorporate power-independent archive for remote signaling events. When power supply is interrupted, the values of remote signals are stored in the energy-independent memory, which allows determining the change in the vehicle during the period of inoperability after restoration of power supply.

Remote control (RC) — control of switching equipment (switch on, switch off). Extra channel, which can be used for check back or permission of fixation. A combination of electronic key and electromagnetic relay in the control channels excludes the possibility of false commands, ensures absence of electric arc during commutations of AC and DC voltage up to 250 V, mechanical clearance in open position allows continuous diagnostics of remote control circuits. Protection of remote control channels from short circuit.

Remote measurement (RM) — measuring voltages and load currents, P, Q, S in direct and reverse direction with accuracy ne less than 0.5 or 0.2.
Selection of measured values of the rated current and voltage is performed by software that allows using a single hardware platform for different nominals of the measured values.
Calibration interval for TOPAZ remote control equipment is 10 years.

REMOTE SIGNALING CHANNELS

Polling period of RS sensors, ms	Protection against noise and overloading according to GOST R IEC 870-3-93	Test voltage of electrical isolation for group, V	Remote control circuit voltage, V	Input current, A	Impedance, Ohms
0,5–10	2	2500	=/~ 5…48 V	5…10	0,5…9,6
			=/~ 48…100 V	2…3	16…50
			=/~ 100…220 V	1…3	50…220

REMOTE CONTROL CHANNELS

Characteristic	Value
Switching voltage, V AC DC	5 …. 275 5 …. 400
Switching current AC / DC	1 /1,5 A – continuously 3,0/4,0 A – 10 s 5,0 / 7,0 A – 1 s 15 A – 0,1 s
Remote control command duration, s	0,1 … continuously
Number of operations under load (at least):	100 000

INPUT / OUTPUT CHANNELS

Analog inputs	voltage measurement Current measurement frequency measurement Accuracy class	± 10; 0-57,7/ 100/ 230 ± 20 мА; 0-1,5 или 0-7,5 А 40-70 Hz 0,1; 0,2; 0,5;
Digital Inputs	circuit voltage Current	AC/DC 5…220 1…10 mA
Discrete control channels voltage	circuit voltage Input resistance, MOhm	1…310 V 3,6 MOhm
Digital Output Channels	switching voltage Switching current AC / DC	AC/DC 5…275/400 1,0 / 1,5 A – continuously 3,0 / 4,0 A – 10 s 5,0 / 7,0 A – 1 s 15 / 21 A – 0,3 s

REMOTE MEASURING CHANNELS

Characteristic	Value
Rated voltage (phase-to-ground / phase-to-phase), V	3 * 57,7 /100 3 * 230 / 400
Rated current (Ia, Ib, Ic), A	1/5
Maximum current (Ia, Ib, Ic), A	7,5
Rated mains frequency, Hz	50
Measurement range – Voltage, – current (Ia, Ib, Ic), A – current (3Io), A – Frequency, Hz – Power factor	17…276 0,01…7,5 0,01…5,0 40…60 0 (cap.) – 1,0 – 0 (ind.)
Limits of permissible relative error in the measurement, %: – voltage; – current; – frequency; – active power; – Reactive power	± 0,5 ±0,5 ± 0,2 ± 0,5 ± 1,0
Limits of the basic reduced error,% as measured cos, degrees	± 2,0
Accuracy class for active energy, GOST R 52323-2005	0,5 S
Accuracy class for reactive energy, GOST R 52425-2005	1,0

DIELECTRIC STRENGTH

Parameter	Russian standard	European standard	test level
Galvanic isolation	GOST R 51841	PN-EN 60255-5	2,5 kV/s мин/ RMC
Voltage surge	GOST R 51841	PN-EN 60255-5	5 kV 1.2/50 microseconds

TOPAZ BAY CONTROLLER

is used for building decentralized APCS and IATS as a unit for acquisition, processing of analog and discrete information about the object, and control the switching equipment. It consists of a set of microprocessor functional modules interconnected with a hardware bus.
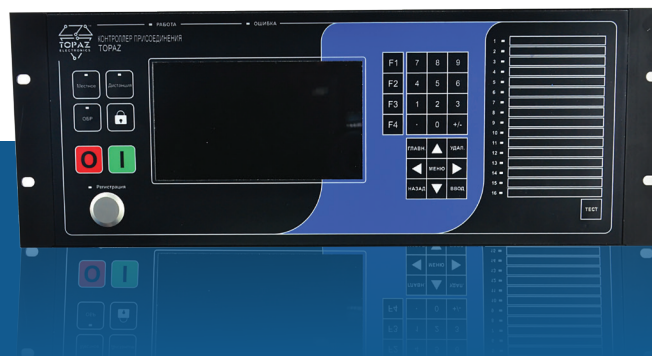
SUPPORTED COMMUNICATION PROTOCOLS
— IEC 61850-8-1 (MMS SERVER) –
   COMMUNICATION WITH SCADA, RC
— IEC 61850-8-1 (GOOSE SUBSCRIPTION / PUBLISHING) –
   DATA EXCHANGE WITH OTHER UNITS OF APCS, RELAY
   PROTECTION, EA, RC
— IEC 61850-9-2LE (SV SUBSCRIPTION) –
   RECEPTION OF MEASUREMENT DATA FROM DIGITAL
   CURRENT AND VOLTAGE TRANSFORMERS
— IEC 60870-5-104 (MASTER / SLAVE) – COMMUNICATION
   WITH RC SUBSYSTEM, DEVICE INTEGRATION
— IEC 60870-5-101 (MASTER / SLAVE) – COMMUNICATION
   WITH RC SUBSYSTEM, DEVICE INTEGRATION
— IEC 60870-5-103 (MASTER) – DEVICE INTEGRATION
— MODBUS-RTU (MASTER) – DEVICE INTEGRATION
— MODBUS-TCP (MASTER) – DEVICE INTEGRATION
— SPABUS.

TOPAZ BAY CONTROLLER FUNCTIONS:

- monitoring of switching equipment state
- information acquisition about the current analog values of direct measurement parameters (I, U)
- calculation of mode parameters based on the signals from the current and voltage transformers
- Interlocking of switching equipment
- remote control of on-off objects (RC) with a precedent object selection and protection against false tripping
- redundant control in case of failure or lack of upper level APCS
- integration of microprocessor RPA, EA equipment, etc. using digital communications protocols

- support of protocols for seamless redundancy HSR and PRP
- information acquisition on the state of on-off (or more complex) objects (RS) with detection accuracy of 1 ms
- measuring of normalized analog signals
- continuous formation of event archive
- filtration of RS chattering
- automatic self-test of all channels (RS, RM, RC) with displaying information on the unit's display and information transmission over communication channels
- data exchange with the upper level equipment in cyclic, sporadic transmission mode or at the request using IEC

  61850-8-1 MMS, GOOSE IEC 60870-5-104 protocols or two independent Ethernet network channels
- Gathering measurements from digital CT, VT and AMU through IEC 60870-9-2LE protocol
- fault recording
- providing redundancy of functions via two Ethernet ports for connection to LAN

MERGING UNITS, SERIES TOPAZ AMU, ADMU, DMU

TIME SYNC DEVICES

ANALOG SIGNALS MEASUREMENT	
Number of channels	up to 8
Possible combinations of channels	4U/4I, 8U, 8I, 4U, 4I
Sampling rate	1000, 4000, 12800 Hz
Current measurement range	0,01-50 A 0,05-200 A
Voltage measurement range	5,75-440 V
Current measurement error	±0,1 % (up tu 10 A), ±0,5 % (above 10 A)
Voltage measurement error	±0,1 %

DIGITAIL INPUT/OUTPUT	
Digital inputs	8 digital inputs, 3 voltage digital check channels
Voltage range	5 … 220 V
Connection type	voltage measurement, «dry contact»
Digitail outputs	3 control relays
Maximum switching current	5 A

DATA TRANSMISSION	
Ethernet	RJ-45, LC single/multi-mode, 100 Mb/s
Data transfer protocols	IEC 61850-9-2 (SV), IEC 61850-8-1 (GOOSE)
Time synchronization protocols	PTP, PPS
Network redundancy protocols	PRP, HSR

POWER SUPPLY	
Power supply voltage	2 channels, 24 V DC (9 – 63 V) or 220 V AC (90 – 264 V)

TOPAZ AMU devise relates to Stand-Alone Merging Unit (SAMU) class of devices and is used for analog-to-digital conversion of input signals from the instrument current transformers and voltage transformers and transmitting the measured data digitial process bus layer over Ethernet network in Sampled Values format using IEC 61850-9-2. Due to rich range of analog channel options, the module may be used for the needs of relay protection as well as for energy metering and power quality measuring systems.

TOPAZ DMU devise is intended for remote control and remote signaling using IEC 61850-8-1 GOOSE protocol.

TOPAZ ADMU devise combines the functionalities of TOPAZ AMU and TOPAZ DMU devise, and transmits the sampled values and digitial signals using IEC 61850-9-2 and IEC 61850-8-1 protocols.

TOPAZ PTS 100 procession time server is intended for forming the time scale synchronization with UTC (SU) time scale by radio signals from GLONASS and GPS navigation systems and for time synchronization of technological equipment and communication network equipment via RS-485 and Ethernet channels or 1PPS
The module may be used for time sync of AMU, ADMU.
Absolute offset of own time scale as compared to UT time scale in synchronization mode by GLONASS/GPS does not exceed 200 ns
Time measurement error in offline mode under normal conditions does not exceed 170 ms per 24 h.

TIME SYNCHRONIZATION	
Ethernet	RJ-45, LC single/multi-mode, 100/1000 Mb/s
Time synchronization protocols	NTP v2/v3/v4, SNTP v3/v4, PTP v2 (IEEE 1588-2008)

POWER SUPPLY	
Power supply voltage	2 channels, 24 V DC (15 – 30 V) or 220 V AC (90 – 264 V)

TOPAZ PM7 MULTIFUNCTIONAL MEASURING DEVICE

— Measurement of three-phase electric grid parameters
— Measurement and registration power quality parameters
   per IEC 32144-2013, IEC 30804.4.30-2013, STO 56947007-
   29.200.80.180-2014 (FGC)
— Fixing of SC, SLGF, intermittent SC,SPGF
— Emergency events recording

designed for application in APC systems and telemechanics systems,
as well as for the implementation of the Smart Grid concept.

MODIFICATION	TOPAZ PM7-W	TOPAZ PM7-E	TOPAZ PM7-D	TOPAZ PM7-Q	TOPAZ PM7-R
Functionality	• telementry, • energy metering	• telementry, • energy metering • PQ basic set, • emergency events recorder	• telementry, • Earth fault and short circuit detection • electricity metering	• те telementry, • metering • EPQI as per GOST 32144-2013, GOST 30804.4.30-2013, STO 56947007-29.200.80.180-2014 (FGC)	• telementry, • metering
Communication interfaces	2 channels RS-485	up to 3 channels RS-485, up to 4 channels Ethernet 100BASE (4Tx/4Fx/2Tx/2Fx)	up to 2 channels RS-485, до 4 каналов Ethernet 100BASE (4Tx/4Fx/2Tx/2Fx)	up to 4 channels RS-485, up to 2 channels Ethernet 1000BASE (2Tx/2Fx(SFP) up to 4 channels Ethernet 100BASE (4Tx/4Fx/2Tx/2Fx)	up to 4 channels RS-485, up to 2 channels Ethernet 1000BASE (2Tx/2Fx(SFP) up to 4 channels Ethernet 100BASE (4Tx/4Fx/2Tx/2Fx)
Digitial inputs	no	8 digitial	no	up to 32 digitial inputs, up to 3 channels of voltage digitial check	up to 32 digitial inputs, up to 3 channels of voltage digitial check
Digitial otputs	no	no	no	up to 16 signal relays, up to 3 control relays	up to 16 signal relays, up to 3 control relays
Data transfer protocols	IEC 60870-5-101, Modbus	IEC 60870-5-101, Modbus, IEC 60870-5-104, IEC 61850-8-1	МЭК 60870-5-101, Modbus, МЭК 61850-9-2, МЭК 61850-8-1	МЭК 60870-5-101, Modbus, МЭК 61850-9-2, МЭК 61850-8-1	МЭК 60870-5-101, Modbus, МЭК 61850-9-2, МЭК 61850-8-1
Power supply	one channel 24 V DC (15 – 30 V)	one or two channels: 24 V DC (15 – 30 V) or 220 V AC (90 – 264 V)	one or two channels: 24 V DC (15 – 30 V) or 220 V AC (90 – 264 V)	one or two channels: 24 V DC (15 – 30 V) or 220 V AC (90 – 264 V)	one or two channels: 24 V DC (15 – 30 V) or 220 V AC (90 – 264 V)

MULTIPURPOSE MICROPROCESSOR UNITS SERIES HVD3 AND TM

Multifunctional remote terminal units (RTU) allow monitoring and control of medium and high voltage metal clad switchgear cubicles. RTU perform the functions of monitoring of power characteristics, signaling of status of bays and control of cubicles at electrical substations as part of APCS and RC. RTU series TOPAZ HVD3 or sets of plastic DI/DO modules TOPAZ MTU5-Pr and meters TOPAZ TM PM7- Pr for high voltage bay control.

OPTIONSOPTIO

	HVD3–RTU1	HVD3–RTU3	HVD3–RTU5	HVD3–RTU7	HVD3–EM3	TM MTU5-Pr	TM PM7-PR
RM channels: Current	-	1	3	4	3	-	4
Voltage	-	-	3	3	3	-	3
RS channels: - «dry contact»	8	8	8	12 (2x6)	8	8	-
- Voltage measurement	3	3	3	3	3	3	-
RC channels:	3	3	3	3	-	3	-
Measurement of active energy	-	-	+	+	+	-	+
Measurement of reactive energy	-	-	-	Acc. cl. 0,2 S	Acc. cl. 0,2 S	-	Acc. cl. 0,2 S
3Io measurement	-	-	-	Acc. cl. 1.	Acc. cl. 1.	0.5 ... 9.6	Acc. cl. 1.
Communication interface [1]	1 or 2 RS485-T	1 or 2 RS485-T	1 or 2 RS485-T	1 or 2 RS485-T or RS485-F in any combination	1 or 2 RS485-T	1xRS485 / CAN	2xRS485 / CAN
Communication protocols	IEC 870-5-101 or Modbus RTU	IEC 870-5-101 or Modbus RTU	IEC 870-5-101 or Modbus RTU	IEC 870-5-101 or Modbus RTU	IEC 870-5-101 or Modbus RTU	IEC 870-5-101, Modbus RTU and CANOpen	IEC 870-5-101, Modbus RTU and CANOpen
Parameterization interface	USB	USB	USB	USB	USB	USB	USB
Current consumption, mA	0.5...9.6	150	150	200	150	140	140
Dimensions (length x width x height), mm	120x100x35	120x00x50	120x100x50	159x100x63	120x100x50	114,5x 99x45	114,5x 99x22,5

[1]RS485-T – units are connected with copper wire; RS485-F – units are connected via optical fiber lines.

DIGITAL INPUT MODULES

Digital Input Modules are intended for use as an interface device with the object (IDO) of the lower level to perform the functions:
— Remote signaling of discrete state of the objects;
— Pulse counting;
— Data transmission via communication channels of the remote control network.

ANALOG INPUT MODULES TOPAZ TM AIN8-PR

Each channel can be configured for voltage and direct current measurement.

Selecting the input parameter by inserting / removing jumpers on the module's PCB.

OPTIONS

	MS DIN16C AC / DC5-220V-Pr	MS DIN32C AC / DC5-220V-Pr	TM DIN32C -Pr	TM CIN8 -Pr
housing material	metal	metal	plastic	plastic
RS channels	16	32	32	8
Galvanic isolation of channels	group	group (2x16)	group (2x16)	individual
communication interface	2hRS485	2xRS485	1xRS485 / CAN	1xRS485 / CAN
Communication protocols	IEC 870-5-101 or Modbus RTU	IEC 870-5-101 or Modbus RTU	IEC 870-5-101, Modbus RTU and CANOpen	IEC 870-5-101, Modbus RTU and CANOpen
technical interface	USB	USB	USB	USB
Current consumption, mA	0.1; 0.2; 0.5;	0.1; 0.2; 0.5;	0.1; 0.2; 0.5;	50
Overall dimensions, mm	106x100x70	210x10x70	114,5x 99x45	114,5x 99x45

	TOPAZ TM AIN8-Pr
housing material	plastic
Measuring channels	8
measurement range	0 – 10 V 0 – 20 mA
Limits of the basic reduced error,%	± 0,1
Galvanic isolation of channels	individual
communication interface	2x RS485
Communication protocols	IEC 870-5-101 or Modbus RTU
technical interface	USB
Current consumption, mA	0.5...9.6
Overall dimensions, mm	106x99x22.5

DIGITAL OUTPUT MODULES

Discrete output modules are used as lower level ODR at control objects for connecting actuators with discrete control.

OPTIONS

	MS DOUT8 AC / DC5-220V-Pr	MS DOUT16 AC / DC5-220V-Pr	TM DOUT8 MP-Pr	TM DOUT16 MP-Pr	TM DOUT8 SP-Pr	TM DOUT16 SP-Pr
Housing material	metal	metal	plastic	plastic	plastic	plastic
RC channels	8	16	8	16	8	16
relay type	A	A	C	C	A	A
communication interface	2xRS485	2xRS485	RS485 / CAN	RS485 / CAN	RS485 / CAN	RS485 / CAN
Communication protocols	IEC 870-5-101, Modbus PTU	IEC 870-5-101, Modbus PTU	IEC 870-5-101, Modbus PTU	IEC 870-5-101, Modbus PTU or CANOpen	IEC 870-5-101, Modbus PTU or CANOpen	IEC 870-5-101, Modbus PTU or CANOpen
configuration interface	USB	USB	USB	USB	USB	USB
Current consumption, mA	190	240	190	240	190	240
Overall dimensions, mm	106x100x70	210x10x70	114,5x99x22,5	114,5x 99x45	114,5x99x22,5	114,5x 99x45

ANALOG OUTPUT AND THERMAL RESISTANCE MODULE TOPAZ AOUT

The module is designed for connection of thermal resistances, measurement of their values and subsequent transmitting measured values via RS-485 network, or for generation of analog signals on output terminals over four channels.

CHARACTERISTICS

Characteristic	Value
Thermal resistance measurement channels	
Number of channels	4
Temperature range, °C	-50...250
Basic absolute error	0,2%
Connectivity type	double-wire, three-wire, four-wire
Analog output channels	
Operating mode	current output (DC), voltage output (DC)
Limit of permissible reduced error	0.1 %
Output ranges in voltage output mode, V	From 0 to 5, from -5 to +5, from -10 to +10
Number of channels	4
Output ranges in voltage output mode, mA	0 + 24.0 + 20.4 + 20
RS-485 interface	
Number of ports	2
Transmission rate, up to, bit/s	115 200
Exchange protocol	IEC 870-5-101, Modbus RTU
General characteristics	
Power supply	2 inputs 9 + 58 V (DC)
Mounting method	DIN-rack 35 mm
Housing	plastic IP20
Overall dimensions, WxHxD, mm	22.5x99x114.5
Ambient temperature, ºC	-40 to +70

CURRENT CONTROL SYSTEM TOPAZ OCTU

The Current Control System is designed for continuous monitoring of effective values of alternate current in conductors, checking the integrity of the measuring circuits and timely generation of alarms if the set value of electric current is exceeded or if the measuring circuit is broken, as well as measuring the frequency and phase shift of measured currents.

The laser radiation from the near-infrared region semiconductor laser is delivered via a single-mode fiber to an optical current sensor and then to a photoelectric detector where the optical signal is converted into an electrical one. Subsequently the electric signal is amplified and subjected to analog-to-digital conversion with a subsequent digital processing.
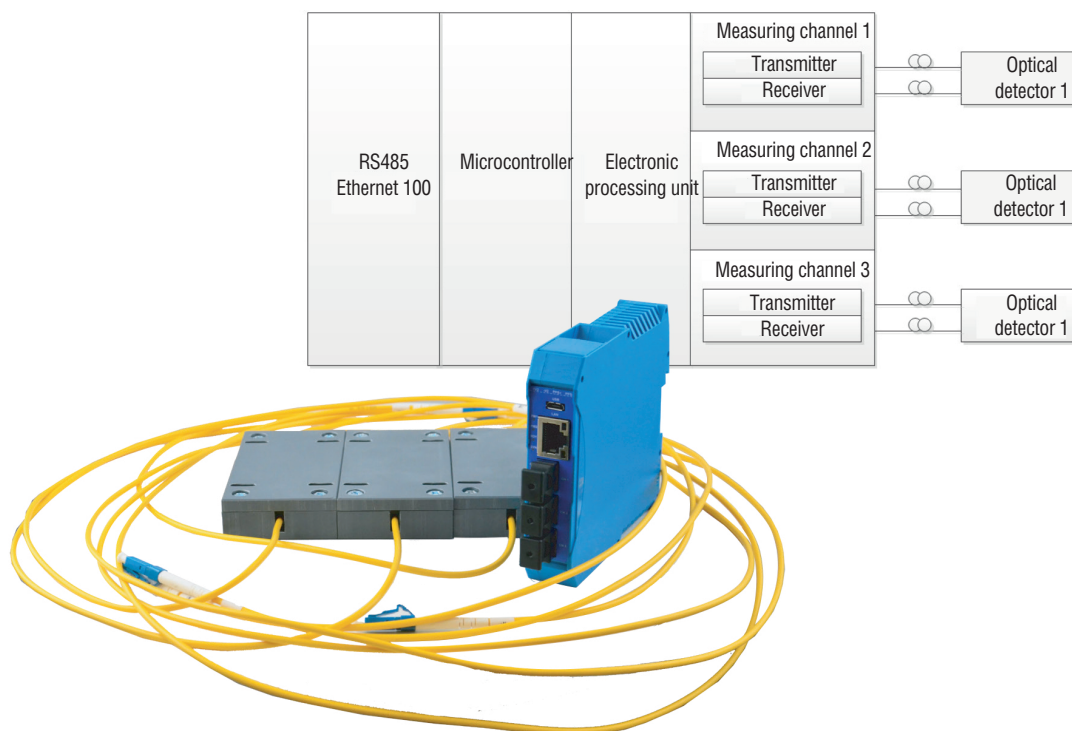
Characteristic	Value
Optic channels for current measurement	
Number of current sensor connection ports	3
Type of current sensor connection ports	LC single-mode 0.2%
Maximum length of fiber optic line, m	1000
Measurement characteristics	
RMS current value, A	up to 1000
Frequency, Hz	30...3000
Phase shift angle between currents I,...°	-180 to +180
Ethernet communication interface	
Data exchange rate, Mbit/s	10/100
Connector type	RJ-45
Supported communication protocol IEC60870-104, SV 61850-9-2 (option) I	IEC 870-5-101, Modbus RTU
RS-485 communication interfaces	
Connector type	Connector T-Bus
Data exchange rate	up to 115200 bit/sec
Supported protocols	IEC 60870-5-101 (slave)
Time synchronization	
Time synchronization protocols	PTP, 1PPS
Difference between the time of internal timer and the time synchronization device in synchronization mode, μs	±1
Ambient temperature, °C	-40 to +70
General characteristics	
Power supply	2 inputs 9 + 58 V (DC)
Mounting method	DIN-rack 35 mm
Housing	plastic IP20
Overall dimensions, WxHxD, mm	22.5x99x130
Ambient temperature, OC	-40 to +70

MODULES FOR SECURITY SYSTEMS

TOPAZ modules for security applications are designed for centralized and autonomous protection of objects against unauthorized intrusion and fire using:
— Control of the state of alarm loops with incorporated safety and fire detectors
— Site access management and control
— Internal and external sound and light alarm devices, sensors and indicators
— Alarms of violation of alarm loops to the remote control and monitoring point, as well as centralized monitoring station (CMS).
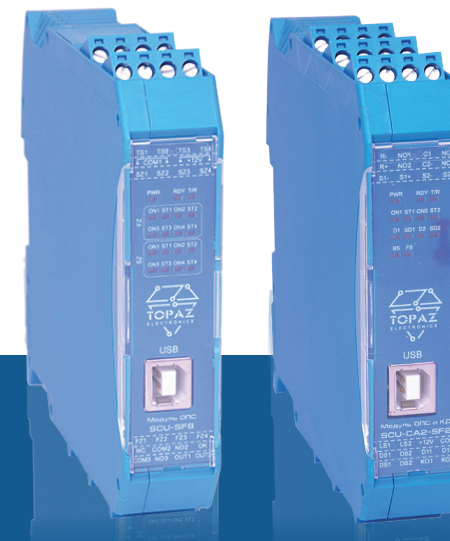
	SCU SF8*	SCU CA2-SF2*
housing material	plastic	plastic
Alarm loops channels	8	2
Digital Inputs – «dry contact» – Unlocking (access)	4 -	4 1
DO channels – electromechanical relays – optical relay	2 1	2 -
+12 V OUT (loop power supply)	1	1
External reader channel	-	1
communication interface	interface RS485 bus	interface RS485 bus
Communication protocols	IEC 7.5	IEC 7.5
Programming Interface devices	USB	USB
Current consumption, mA	150	150
Overall dimensions, mm	114,5x99x22,5	114,5x99x22,5

TECHNICAL SPECIFICATIONS

DI CHANNELS

Characteristic	Value
Voltage at channel terminals, V	12
Type of door status sensors	normally closed
Type of manual control buttons	normally open

DO CHANNELS

Characteristic	Electromechanical relay	Optical relay
relay type	C	A
Switching voltage	250	400
Maximum switching current, A	6	0,1

EXTERNAL READER CHANNEL

Characteristic	Value	Optical relay
Output interface	TOUCH Memory and etc.	A
Type of connected readers	proximity cards	400
code transmission interface	Wiegand 26	0,1

"+12 V" OUT

Characteristic	Value
Voltage, V	12±2
Maximum load current at "+12 V" output, mA	180±20
Short-circuit current at "+12 V" output, mA, not more	200
Magnitude of "+12 V" output pulsation, mV, max	100

Modules have all the necessary certificates for access management and control, warning protection systems and intrusion protection, as well as certificates for the equipment installed at substations.

UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

POWER CONTROLLER TOPAZ PSC 24V10A (40A)

Power supply controller for power management of TOPAZ modules and controllers, sensors, actuators and auxiliary devices, displays and so on, as well as monitoring ambient temperature and controlling the cable heating system.

Includes logic blocks:
— Control and measurement device for input and output voltages
— Redundant power supply sources switching unit
— Battery charging unit
— Temperature control and heating block
— USB port for module setup and configuration

Characteristic	Value
Input voltage channels	3
Nominal input voltage, V	= 24
Output voltage channels	2
Rated output voltage, V	= 24
Maximum total load current, A	10 (40)

Auxiliaries board 1 Auxiliaries board 2 Auxiliaries board 1 Auxiliaries board 2

ACO module
TOPAZ ASR 220V10A

ACO module
TOPAZ ASR 220V10A

Power supply unit
220/24В 40A

Power supply unit
220/24В 40A

Power supply controller
TOPAZ PSC 24V 40A

Power supply controller
TOPAZ PSC 24V 40A

battery

battery

220 V load

24 V load
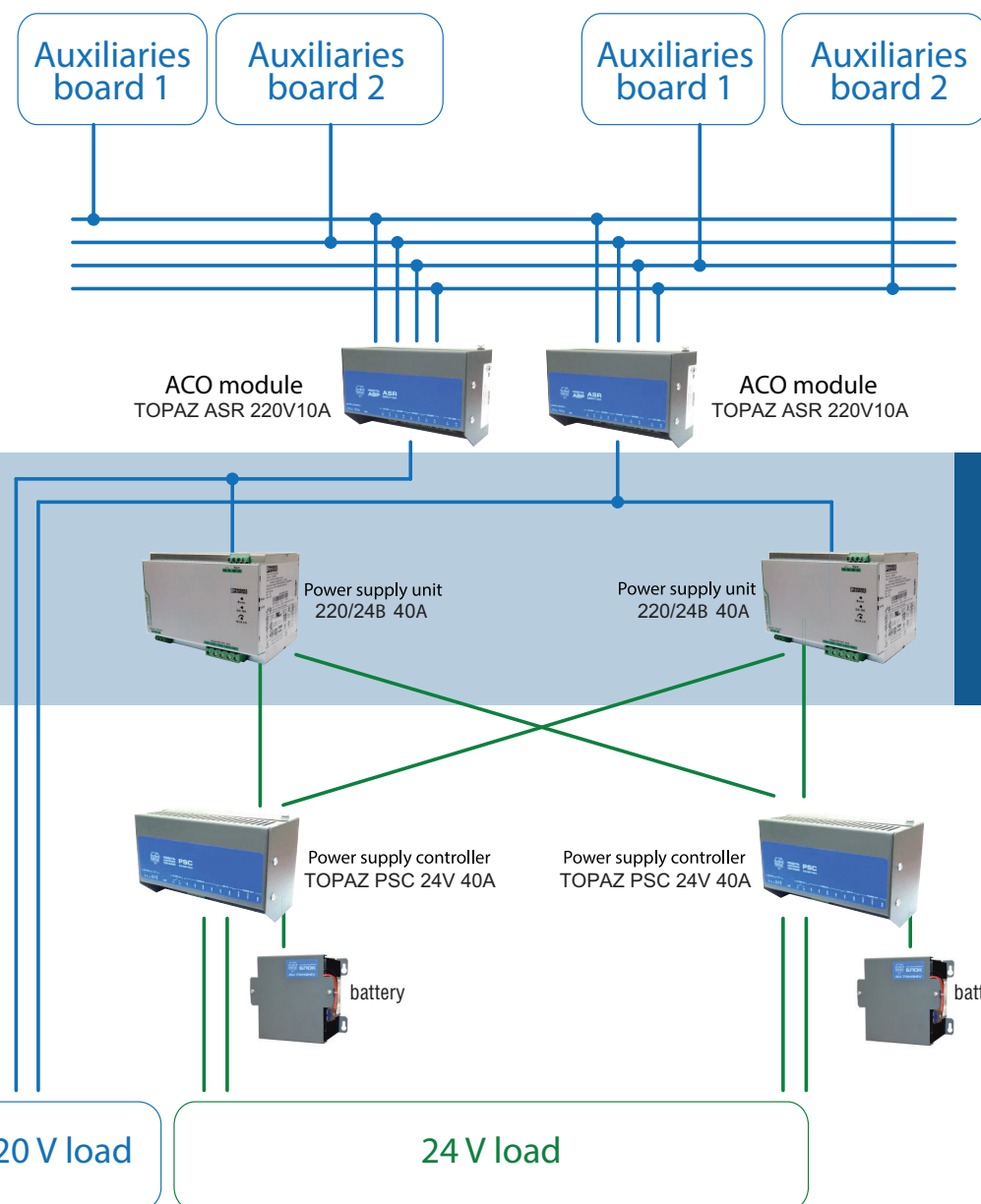
ELECTRIC INVERTER TOPAZ PSI-960W 24VDC / 220VAC

DESCRIPTION:
— Power supply inverter for units with high dependence on the quality of the AC voltage
— Inverter perfectly complements HSS TOPAZ uninterruptible power supply system with 220 V AC loads
— Allows operating with all types of loads: active, inductive, capacitive, including transformers, AC motors, as well as household electric appliances

PROTECTION TYPES:
Short circuit, overload, reverse polarity, exceeding voltage, thermal protection, electric isolation

SPECIFICATIONS

Parameter	Value
Input voltage channels	2
Nominal input / output voltage, V	=24/~220 ± 10
Output voltage channels	1
Sinusoidal waveform distortion (max),%	5
Rated output power , W	960
Maximum output power, W	1200
Dielectric strength, kV rms:	2,5
Interference level (group as per GOST 51527)	C
Dimensions (length x width x height), mm	440; 260; 134
Enclosure protection index	IP20

SUPERCAP BACKUP POWER SUPPLY MODULE TOPAZ RPS24VXA-3M

DESCRIPTION:
— A module for maintaining the power supply of 24V DC load during short failures of the external power supply and for correct equipment shutdown if the external power supply fails.
— Module operates on the principle of energy storage in supercapacitors' electric field when operating in the buffer mode.

SPECIFICATIONS

Parameter		RPS24V1A-3M	RPS24V40A-3M
Dimensions (length x width x height), mm		160; 100; 77	440; 245;134
Enclosure protection index		IP20	IP20
Input voltage, V		=15...30	=15...30
Rated output voltage (when the input power is present), V		=22±2	=22±2
Power consumption from the main power source in idle mode (considering charging current), not more, VA		12	24
Permissible load, not more, VA		240	1000
Battery life at 1 A load, min		3	30
DO	Amount	1	2
	Commutated AC current, mA	200	
	Max surge current (up to 3 seconds), mA	400	
	insulation level, kV	2,5	
	Response time, ms	5	
	release time, ms	2,5	
	Minimum service life, operations	100 000	

The TOPAZ SW series Ethernet switches are used for building local networks by connecting several network segments or several network joints inside a single segment. TOPAZ SW series is designed as a part of APCS, telemechanics, and dispatch control centers in energetics, including digital substations or other industries such as agriculture and housing and communal services.

The TOPAZ SW devices serve as a platform for implementing the functions of switches in the third OSI layer.

The TOPAZ SW 5xx switch implements the functions of switches in the third OSI layer.

The switches TOPAZ SW are unmanaged industrial switches. Swtich TOPAZ SW are customizable for various projects: the number and type of ports (optical, copper, 100 Mb/s, 1 Gb/s) are determined during ordering.

TECHNICAL SPECIFICATIONS OF THE SWITCH TOPAZ SW 5XX	
Standards	IEEE 802.3 for 10BaseT;
	IEEE 802.3u for 100BaseTx and 100BaseFx;
	IEEE 802.3x for Flow Control;
	IEEE 802.1D for Spanning Tree Protocol;
	IEEE 802.1w for Rapid Spanning Tree Protocol;
	IEEE 802.1D-2004 for Spanning Tree Protocol;
	IEEE 802.1s for Multiple Spanning Tree Protocol;
	IEEE 802.1Q for VLAN Tagging;
	IEEE 802.1p for Class of Service;
	IEEE 802.1X for Authentication;
	IEEE 802.3az Energy Efficient Ethernet
industrial protocols	Ethernet/IP; IEC 61850-8-1; IEC 61850-9-2; IEC 60870-5-104; Modbus/TCP
Controls	IPv4, IPv6 control;
	SNMP v1/v2c/v3;
	Telnet/SSH;
	Console – CLI;
	Web;
	DHCP (Client/Option 82/Relay Agent/IP-Port Binding)
Filtration protocols	802.1Q; VLAN Unaware; Port-Based VLAN; GVRP
Redundancy protocols	STP/RSTP; MSTP; PRP; HSR; Static Port Trunk

Cyber security	Built-in policy management module based on TCAM (PCL) supporting 256 rules, including filtering rules, VLAN assignment, QoS packets marking, switching policies. Authentication – Radius; Authentication Certificate - SSL Certificate/SSH Key Regenerate; 802.1X – Port Based; Port Security – Static MAC Port Lock; Loop Protection; Rate Limit
Time synchronization protocols	SNTP; NTP Server/Client; IEEE 1588v2 (PTP v2)
Flow control	IEEE 802.3x flow control, back pressure flow control
Number of supported MAC addresses	16000
Packet buffer size, kbytes	2048
MIB	MIB-II, Ethernet-like MIB, P-BRIDGE MIB, Q-BRIDGE MIB, Bridge MIB, RSTP MIB, RMON MIB Group 1, 2, 3, 9
VLAN AND QOS FUNCTIONS	
VLAN organization	Port-based
VLAN maximum number	4096
Double tagginge	Q in Q mode
Number of QoS traffic classes	8
QoS definition	Port, IEEE 802.1p, TOS/DS, IP4 TOS&DS, IPv6 TC 802.1Q VID, MAC address
Modes of QoS prioritization per port	Strict (SP), Weighted (WRR), Mixed

GENERAL TECHNICAL CHARACTERISTICS	
PARAMETER NAME	VALUE
Mounting method	DIN rail 35 mm
Number of power supply channels	2
Galvanic isolation, kV	2,5
Mean time between failures, h	140 000
Mean time to recover at the operation facility, not more than, minutes	30
Average service life, years	30
Weight of the device, kg, not over than:	1,0
Degree of protection as per GOST 14254-2015	IP20
Class according to the method of protection of humans against electric shock as per GOST 12.2.007.0-75	I

OPERATING CONDITIONS	
PARAMETER NAME	VALUE
Operating temperature range, oC	- 40 …. + 70
Relative humidity (at temperature not over 30 oC), %	up to 100
Atmospheric pressure, kPa	66,0….106,7
Rated power supply voltage (depending on the modification), V: • DC/AC; • DC	220 24
Power consumption per one functional board, W, up to:	3

TOPAZ FW ROUTING DEVICE

OPERATIONAL FEATURES	
Firewall	• Static packages filtering • Filtering by IP addresses, protocols and ports • NAT source and destination address translation • Tracking TCP sessions, monitoring the correct connection establishment • Filtering Support with the use of address sheets
Routing	• Static routing • Policy-based routing • Rule-based routing for interfaces - dynamic routing: RIP v1/v2, OSPFv2, BGPv4 • Router redundancy using VRRP protocol
Industrial protocols	• Ethernet/IP; • IEC 61850-8-1; • IEC 61850-9-2; • IEC 60870-5-104; • Modbus/TCP
Control	• IPv4, IPv6 control; • SNMP v1/v2c/v3; • SSH • Console - CLI; • Web; • DHCP (Client/Option 82/Relay Agent/IP-Port Binding)
Filtering protocols	• 802.1 Q; • VLAN Unaware; • Port-Based VLAN; • GVRP
Redundancy protocols	• STP/RSTP; MSTP; PRP; HSR; Static Port Trunk
VPN	• Ipsec with the use of tunnel and transportation modes, authorization by certificate or PSK key, AH/ESP protocols • Hardware support for AES encryption with 128/256-bit key • Tunneling protocols: OpenVPN, PPTP, L2TP
DHCP	• DHCP server/client, DHCP-relay • Static and dynamic address ranges • Support of Radius • Support for configurable DHCP options

TOPAZ GSM ROUTER

TOPAZ GSM router is a means of communication and a freely programmable device (router), designed to resolve communication, automation, tele-mechanics and dispatching tasks. It is used to set up communication channels of systems for monitoring and control of engineering equipment at various objects.

PARAMETER NAME	VALUE
Up to 32 Ethernet ports	RJ-45, FX LC (single-/multi-mode), SFP
Up to 32 ports	RS-485, RS-422, DB9
Time synchronization	GLONASS/GPS (option), PTP
1 or 2 power inputs	24, 48, 220 V
Operating temperature	from -40 to +70 ºC;
SIM-cards Data communication standards	two mini-SIM, or SIM-chip (option) 3G modem CSD, GPRS, EDGE, UMTS, HSPDA, HSUPA
	4G modem CSD, GPRS, EDGE, UMTS, HSPDA, HSUPA, HSPA+, DC-HSPA+, LTE

VOLTAGE CONVERTERS

Power Supply / DC converters – a new generation of products, characterized by high reliability, efficiency and ease of use.
Designed to power TOPAZ modules and controllers, sensors, actuators and auxiliary devices, display, etc.

OPTIONS

	PW220/24V25W-AC/DC	PW220/24V50W-AC/DC	PW24/12-5-3,3V24W-DC/DC	PW24/220V25W-DC/DC
Input voltage V DC AC	90…380 90…270	90…380 90…270	19,2…30 -	19,2 …30 -
Output voltage channels	1	1	3	1
Output voltage, V	= 24 B	= 24 B	=12B =5 B =3,3 B	= 220 B
Maximum load current, A:	1,0	2,0	3; 10; 15	0,1
Maximum output voltage error,%, not more	± 2	± 2	± 2	± 2
over-current protection threshold	1,2…1,8 Imax	1,2…1,8 Imax	1,2…1,8 Imax	1,2…1,8 Imax
Magnitude of the output voltage ripple, mV	100	100	60	60
Instability of output voltage during variations of supply voltage,% max	± 0,2	± 0,2	± 0,2	± 0,2
Instability of output voltage during load current variation from 0.1Imax to Imax,%	± 0,2	± 0,2	± 0,2	± 0,2
Thermal instability factor of the output voltage in the operating temperature range,% / °C	± 0,025	± 0,025	± 0,025	± 0,025
Interference level (group as per GOST 51527)	C	C	C	C
Dimensions (length x width x height), mm	114,5 x 99 x 22	114,5 x 99 x 22	114,5 x 99 x 22	114,5 x 99 x 22

BACKUP POWER SUPPLY MODULE TOPAZ RPS 24V1A-3M

The module is designed for 24 V supply of technical equipment during short outages of the main power supply.

Disappearance of voltage on the primary power supply channel the module switches power to the emergency channel from the integrated power source and transmits a signal informing about emergency mode. When the voltage at the main power supply channel restores, the module returns to the normal mode.

Main characteristics	Value
Nominal input voltage, V	24
Rated output voltage (when the input power is present), V	24
Weight, kg, no more	1
Dimensions (length x width x height), mm	160 x 100 x 77
release time, ms	0.1 ms

Backup power supply system, parameters	Value
Rated output voltage (in the absence of input power), V	22
Maximum load current, A	1
Stored energy, kJ	4.0
Battery life at 1 A load, min	3

COMMUNICATION EQUIPMENT

Communication equipment is designed for conversion of interfaces and data transfer protocols, concentration and branching in the construction of data acquisition networks.

Interface converters
— TOPAZ PEP-PS485 / PS485-Pr
— TOPAZ PEP-FO / PS485-Pr
— TOPAZ PEP-PS485 / PS232-Pr
— TOPAZ PEP-PS485 / TTL-Pr
— TOPAZ PEP-FO / PS232-Pr
— TOPAZ PEP-PS485 / CAN-Pr
— TOPAZ PEP-FO / CAN-Pr
— TOPAZ TM CI (Ethernet / PS-485 / CAN)

Protocol converter
— TOPAZ CPC 101-02-PrMEDIA CONVERTER

Mediaconverter
— TOPAZ MS-F1 / T1
— OPAZ MC-F1 / T1 (HV)

Interface repeater
— TOPAZ PEP 2FO / PS485-Pr
— TOPAZ PEP 2FO / PS485-Pr (HV)

STRUCTURES OF COMMUNICATION CHANNELS

STRUCTURE 1   STRUCTURE 2   STRUCTURE 3   STRUCTURE 4

IEC 101

PPL modem

private physical line

PPL modem

Internet

residential or office building

Line 0,4 kW

controlled object

controlled object

FO/TP

FO/TP

controlled object

Internet

FO/TP

fiber optic communication line

FO/TP

controlled object
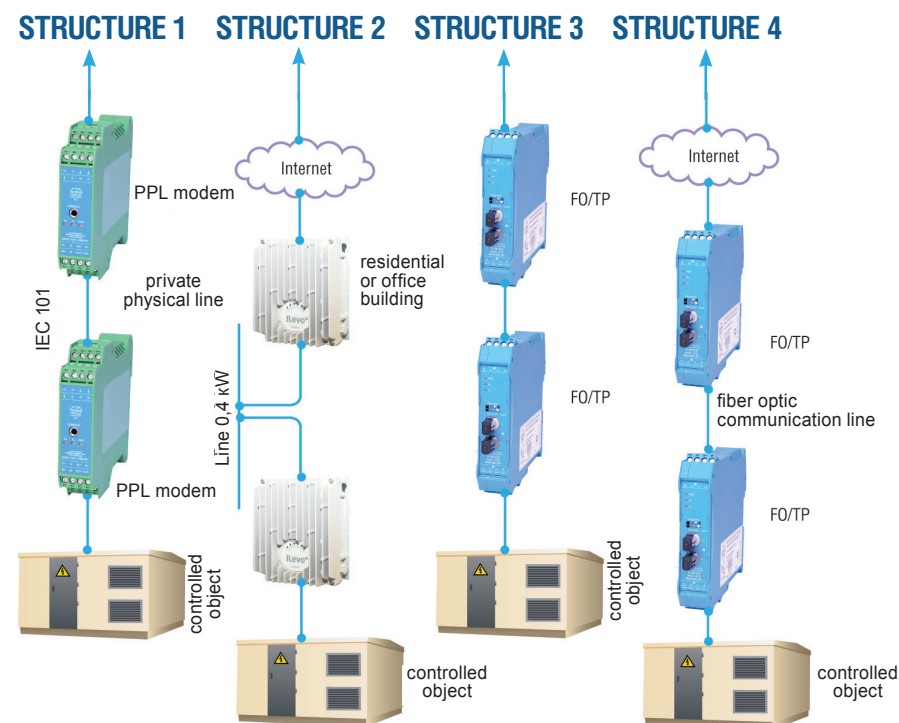
CAR DASH CAMERAS TOPAZ VR

Car dash cameras TOPAZ VR are designed to set up a video surveillance system, which may record, store and transmit videos.
Car dash cameras support web-monitoring and configuration of connected cameras, camera control and event recording.
It is possible to connect PoE/PoE+ cameras.
The number of data communication ports, cameras to be connected and data storage capacity depends on the modification and
is determined according to the customer's requirements.
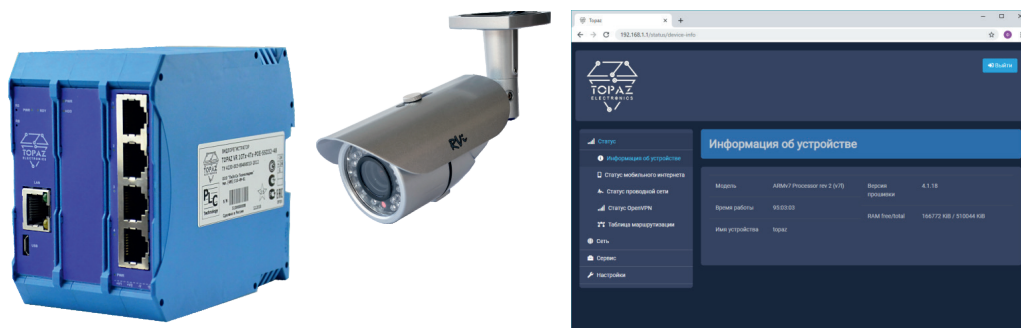
TECHNICAL SPECIFICATIONS

Parameter name	Value
Operating system ROM	Linuxup to 4 TB
Ethernet	up to 16 ports RJ-45, LC, SFP
Industrial protocols	Ethernet/IP; IEC 61850-8-1; IEC 61850-9-2; IEC 60870-5-104
Control	Ipv4, IPv6 control; SNMP v1/v2c/v3; SSH; Console - CLI; Web; DHCP (Client /Option 82/Relay Agent/IP-Port Binding)
Network redundancy protocols	STP/RSTP; MSTP; PRP; HSR; Static Port Trunk

Parameter name	Value
Time synchronization protocols	SNTP; NTP Server/Client; IEEE 1588v2 (PTP v2)
Flow control	IEEE 802.3x flow control, back pressure flow control
VLAN set up	based on ports
Input signal	8xIP (max. 1920x1080)
Streaming video protocols	RTP, RTSP
Camera Event Streaming Log (Motion Detector)	ONVIF
Video compression type	H.264
Record resolution	1920x1080, 1280x960, 1280x720, 720x576, 720x480, 640x480, 352x288
Record rate	8x 25 k/s (1920x1080, 1280x960, 1280x720, 720x576, 720x480, 640x480, 352x288)
Video-stream	1 - 8 Mbit/s
Record modes	Manual, scheduled, event-based (motion detector)
Playback rate	8x25 k/s
PTZ Routes	Available
Manual control	Available

TOPAZ SOFTWARE

GENERAL INFORMATION

TOPAZ software includes execution-ready specialized software components that perform basic functions such as data collection, retransmission, displaying, archiving, logic processing, and so on, that support the operation of all levels of ACS, APCS or IATS, as well as tools for hardware and software configuration of TOPAZ software.

TOPAZ software has a certificate 2012619552 confirming state registration of the software by the Federal Service for Intellectual Property.

CLASSIFICATION OF PROGRAM COMPONENTS

TOPAZ HWConfig – specializes software for configuring field level equipment – IO modules TOPAZ

TOPAZ IEC DAS Control – execution-ready software components (system modules, communication protocols and interface drivers with devices, applications) that exist physically in the form of individual application files and plug-ins and executed on controllers and PC running Linux or Windows.

Work of each of the individual components require special settings made using specialized tools. TOPAZ IEC DAS TMConfig – software (TOPAZ Configurator, TOPAZ DBView, TOPAZ Loader) for:
— Manual configuration of controller's images
— Upload / Download configurations
— Quick access to the current telemetry parameters

TOPAZ IEC DAS-TMBuilder (TOPAZ Parser) – software for automated construction of an integrated remote control systems based on TOPAZ IEC DAS

TOPAZ WEB – application on the base of WEB-technologies to view the current parameters of the complex and fast access to the parameters for adjusting the settings, including through tablets and smartphones via the compact USB-WiFi router. TOPAZ SCADA SERVER - is the head module of the executive subsystem TOPAZ SCADA. Provides an integrated reception, processing and storage of process parameters, security policies, and accounting of users, storage, design-oriented information, providing customers with the system operational and archive information.

TOPAZ SCADA DBConfig – Database Designer for TOPAZ SCADA SERVER software.

TOPAZ SCADA CLIENT – software that is installed on the PC for the organization of the workstation. It is a direct TOPAZ SCADA interface between the user and the system (HMI). It provides visual access to and control of operational and archival information, sound and color alarms and indication.

GRAPHICS SUBSYSTEM.

Complete software for constructing GUI schematics. Is a universal graphics editor allowing creating graphic documents with semantic load, which became the de facto standard for vector graphics in the power engineering sector. Is used as the graphics subsystem not only for TOPAZ SCADA, but also in the operative measuring complex CK-2007, operative measuring complex NTP EXPEPT and others. It consists of three main modules:

— **TOPAZ Editor.** Environment for creating graphical documents and determining the functionality of both the documents and graphic objects contained therein.

— **TOPAZ Explorer.** Environment for using the functionality embedded in a graphic document.

— **TOPAZ Graphics ActiveX Control.** An ActiveX control element providing TOPAZ Graphics functionality for applications.

A set of tools for object-oriented modeling and providing a user interface for work with data of the information system.

TOPAZ Administrator (Model Creator) — Designer of the Object Model TOPAZ SCADA – a module for forming visual object model of the application data in terms of the subject area.

TOPAZ Object Manager (Model Explorer) browser of the object model TOPAZ SCADA – the module for viewing, searching and editing of database information within the object model of the application data.

Software module TQLBuilder
Module for visual building hierarchical queries on data sampling within the object data model.
Software module TQLManager

ActiveX component designed to display the result of the query, created using TQLBuilder.

TOPAZ RASP — software complex recording of emergency events and processes for collecting, processing, storing, and providing a user interface for accessing the data of emergency events and waveforms derived from the digital terminals and the digital fault recorders installed at substations. Access to the data is provided to the user via a standard WEB-browser and software TOPAZ OSC Viewer to view the waveforms.

SOLUTIONS FOR 35 – 220 KV GRIDS

ARCHITECTURE OF APCS AND IATS BASED ON HSS TOPAZ

— upper level (concentration, visualization and data storage): APCS servers of HSS TOPAZ, technological equipment monitoring system; workstations for operator, ACS and relay protection engineers.

— Middle level (of the inter-level internal and external interaction): stationary redundant controllers TOPAZ DAS, network equipment — switches, routers, interface converters, precise time servers, and other communication devices.

— Lower Level (process level): TOPAZ bay controllers, microprocessor transducers, digital position indicators of transformer on-load tap changers, RTU modules, sensors, and microprocessor devices of adjacent autonomous systems of relay protection, ECA, fault location, fault recording, DC board, auxiliary services panel and others.

FUNCTIONS

INFORMATION

1. Organization and management of operational process database that is updated in real time.
2. Acquisition and initial processing of analog and digital signals.
3. Warnings and alarms.
4. Call of the warning and alarm transmission system (Alarm Indicator) for each connection from the process screen
5. Event logging.
6. Archiving, storage and presentation of historical information.
7. Information processing, formation of historical reports and saving them into a dedicated non-operational database.
8. Work with databases of adjacent systems.

MANAGEMENT

1. Remote control.
2. Control of operational blocks.
3. Software blocks
4. Locking of signal transmission from the equipment undergoing maintenance.
5. Manual or automatic replacement of RM - RS data, including the input of disconnector and earthing switches state (pseudo RS), followed by data transfer to the control center.
6. User setting of limits for different levels.
7. Installing warning and prohibiting posters, portable earthing (icons) and "unbolting" on the mimic diagram.

INTEGRATION WITH RELAY PROTECTION, ECA

1. Reading current measurements and updating values in the process database.
2. Reading signals of RS and updating values in the HSS process database.
3. Registration of event information signals from the controller, microprocessor devices of relay protection and ECA with time stamps.
4. Automatic acquisition of waveforms.
5. Reading and management of setting groups.
6. Reading of short circuit currents.

SYSTEM-WIDE

1. System maintenance and administration of HSS.
2. Control and management of user access to HSS.
3. Automatic diagnosis of communication channel state with the lower level devices of the HSS and issuing warning messages if loss of connection with any device is detected.
4. SNMP support in the middle and upper levels for monitoring network devices.
5. Synchronization of HSS components using GPS signal receivers or combined GPS / GLONASS receivers. Support of synchronization protocols NTP, SNTP, IRIG-B, PPS and others.

APCS FOR A 35 – 220 KV DIGITAL SUBSTATION BASED ON THE RUSSIAN HSS TOPAZ
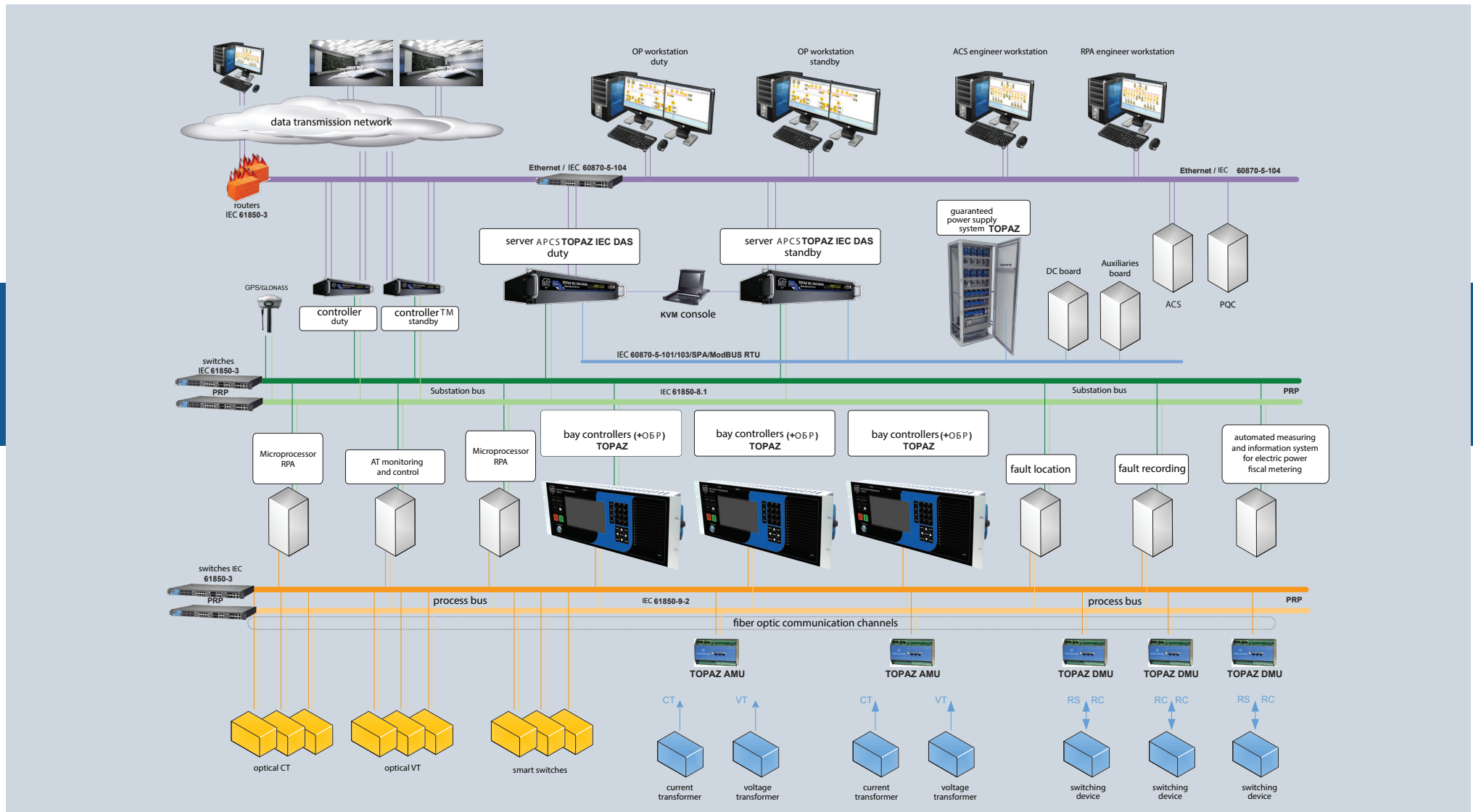
APCS FOR A MODERN 35 – 220 KV SUBSTATION BASED ON THE RUSSIAN HSS TOPAZ
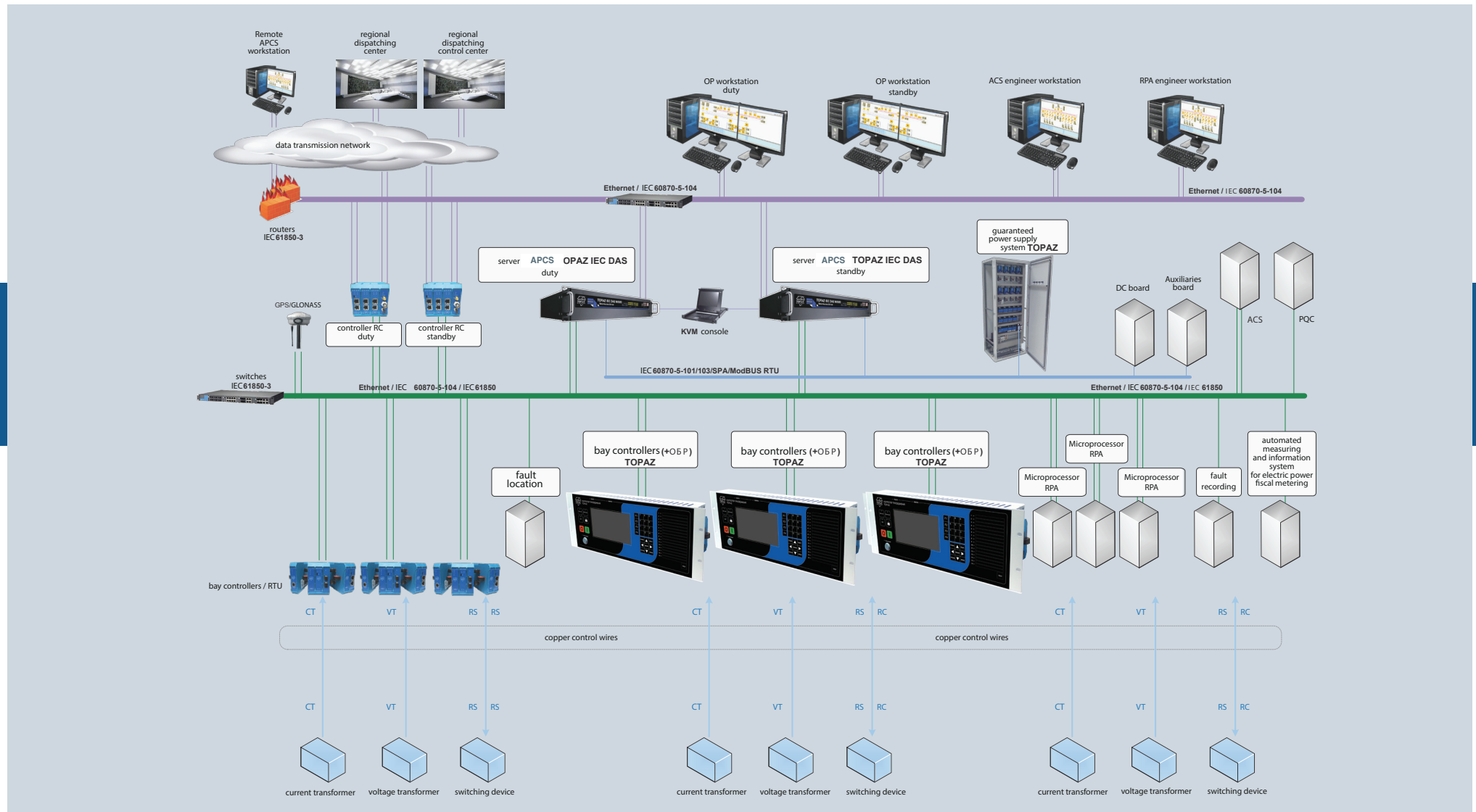
SOLUTIONS FOR 6 - 20 KV GRIDS

DISPATCH CONTROL CENTERS BASED ON TOPAZ SCADA

Building scalable IATS, APCS, ACS.
HSS TOPAZ can be used to create distributed scalable systems, including the level of server clusters and workstation. For example, servers are located at facilities owned by the utility, and workstations are located on the sites leased by regional utility branches.

Configuration and ontology
A specialized tool system is used for configuration, allowing building an object SIM-model for the grid and containing reference books, dictionaries, classification and identification systems for power equipment and facilities. The resulting object models and

mimic diagrams are embedded in the system nodes forming grid diagram. Setting signal-wise traffic is performed automatically, that is, relevance of the information in all nodes the object is built in, is maintained automatically. This technology allows avoid multiple manual insertion and subsequent multiple verification, and use replication performed automatically.

Accuracy
Acquisition, processing and storage of data stamps for operational data with accuracy of 1 ms, two times tamps for each parameter are supported.
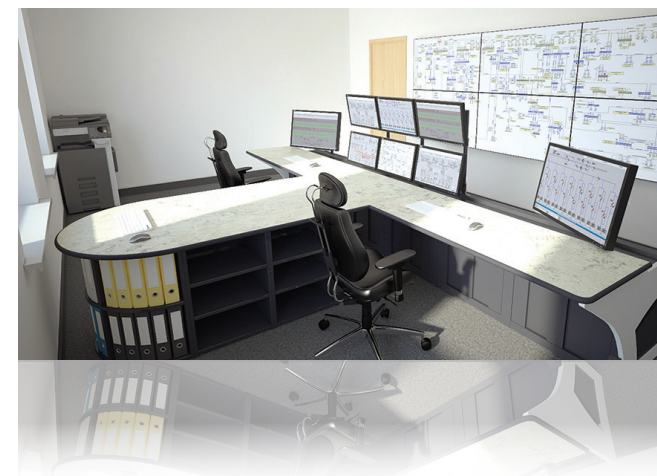
SYSTEM SOFTWARE TOPAZ SCADA ALLOWS IMPLEMENTING:

Collection, processing, visualization and archiving of data on the status and operating conditions of the controlled objects' equipment.

Monitoring of the current modes of equipment and layout of electrical grids, as well as the state of its equipment, including:
— monitor of the current operating mode and historical monitoring of the layout and equipment of the grid on the basis of telemetry data;
— forming and analyzing signals list and trends of equipment operation mode parameters;
— monitoring of the information from auxiliary subsystems (video control, fire sprinklers, etc.);
— formation of archives of specific modes and layouts (normal and maintenance).

Switching control on substations, including:
— operational control of correctness of switching procedures, control of checking operations, basic topological interlocking, interlocking of status and access;
— operational logging;
— formation of reports on the equipment operation and performed switching operations, outages and failures;
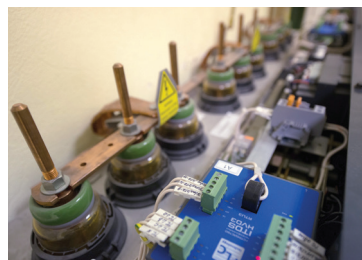— locking of invalid operator switching procedures.

Monitoring of the current state of relay protection devices, emergency (EA) and local automation.

Forming power and energy balance.

REMOTE CONTROL SYSTEM ARCHITECTURE FOR 6, 10 AND 20 KV ELECTRICAL FACILITIES

Wireless digital data transmission channels

High-speed digital data transmission channels

Dial-up data transmission channels

GSM ROUTER

TOPAZ RC communication board

RS-485 (IEC -101)

Ethernet (IEC -104)

RS-485 (IEC -101)

TP/FO

TP/FO

RS-485 (IEC -101)

↑RS↑ТИ↓RC   ↑RS↑ТИ↓RC   ↑RS↑ТИ↓RC   ↑RS↑ТИ↓RC   ↑RS↑ТИ↓RC   ↑RS↑ТИ↓RC

RC BC SG0.4 TOPAZ (ITDS)

ТИ
RS

Т–1 Т–2

ТИ
RS

RC BC SG0.4 TOPAZ (ITDS)

Main bus disconnector switch Line A 0,4 kV

0,4 kV switchgear

Main bus disconnector switch Line B 0,4 kV

ISERE 1200   ISERE 1800

ISERE 1200   ISERE 1800

RS
RS
RS

RS
RS
RS

The range of remote control equipment allows optimally solving problems for remote control of substations of all types, taking into account different options of the primary equipment and a variety of operating conditions.

Remote control of 6 – 20 kV switchgear

Control equipment of the controlled object is designed as a set of remote control, and remote control units — bay controllers installed in the low voltage compartment of the metal-clad switchgear cubicles, SF6 units. Two independent data transmission interfaces allows providing redundancy of data bus or using a second interface for communication with an external remote control panel or controller. Protocol selection is carried out by software.

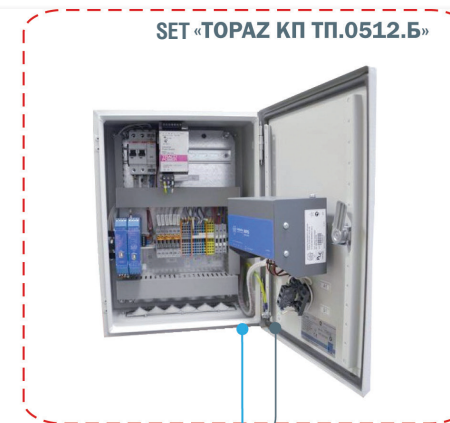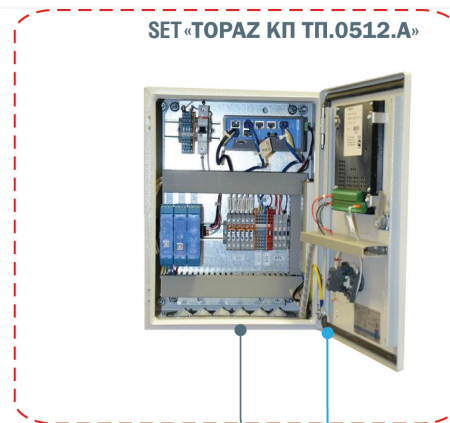## Remote control of 0.4 kV switchgear

Remote control of 0.4 kV switchgear is performed by means of two remote control panels (one for each 0.4 kV bus bar section), with a software-selectable level of controlled voltage 12, 24, 110, 220 – 250 V AC or DC. Voltage presence control is performed on each phase of all outgoing 0.4 kV feeders after each fusible link. TOPAZ AVS voltage sensor is installed directly after the fuse link for each control channel.

REMOTE CONTROL IS PERFORMED BASED ON STANDARD DESIGNS. TYPE PROJECTS HAVE BEEN DEVELOPED AND AGREED FOR ALL MAJOR METAL-CLAD SWITCHGEAR CUBICLES AND SF6 UNITS USED IN RUSSIA.

REMOTE CONTROL OF TRANSFORMER SUBSTATIONS

SET «ТОРАZ КП ТП.0512.А»

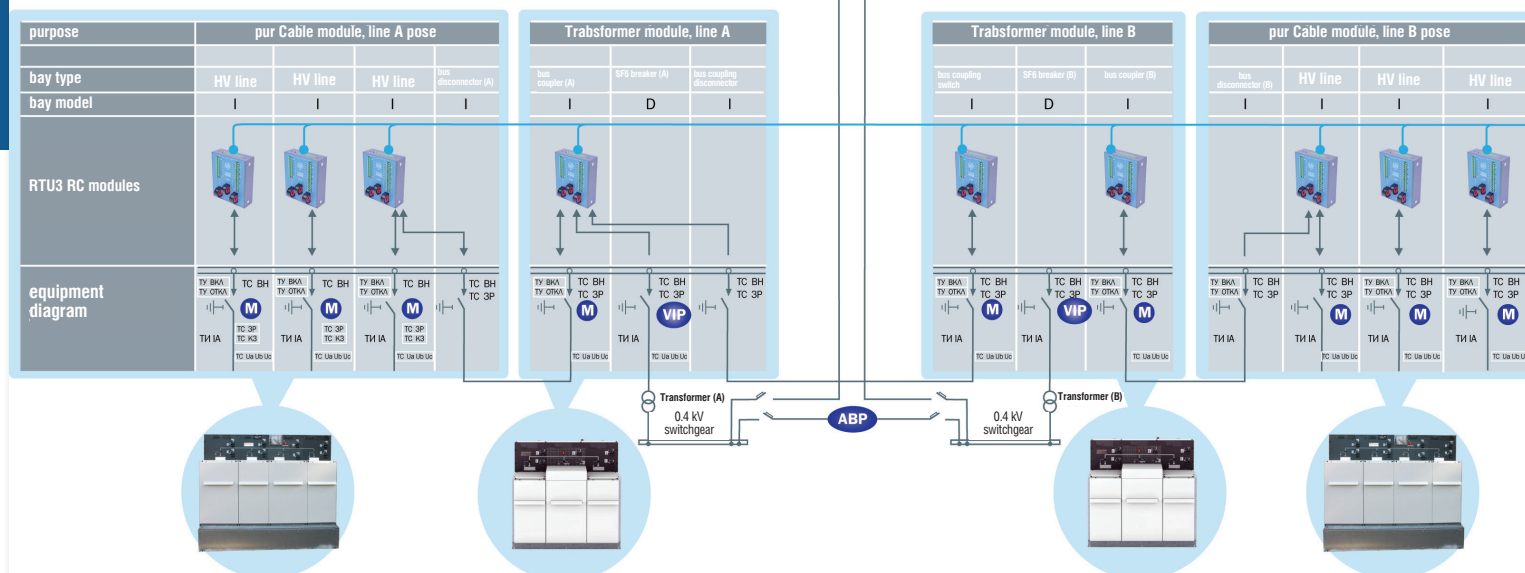SET «ТОРАZ КП ТП.0512.Б»

Ua, Ub, Uc Луч-А
Ua, Ub, Uc Луч-Б

RS-485

RC ON – Remote control – circuit-breaker switch "ON"
RC OFF – Remote control – circuit-breaker switch "OFF"
RS BR – Circuit-breaker is switched on
RS ES – Earthing switch is switched on
RS SC – Tripping of fault current indicator
RS Ua, Ub, Uc – Voltage presence on feeder phases
RM Ia – Remote measurement of current in phase "A"

purpose	pur Cable module, line A pose				Trabsformer module, line A			Trabsformer module, line B			pur Cable module, line B pose			
bay type	HV line	HV line	HV line	bus disconnector (A)	bus coupler (A)	SF6 breaker (A)	bus coupling disconnector	bus coupling switch	SF6 breaker (B)	bus coupler (B)	bus disconnector (B)	HV line	HV line	HV line
bay model	I	I	I	I	I	D	I	I	D	I	I	I	I	I
RTU3 RC modules														
equipment diagram														

Transformer (A)
0.4 kV switchgear

ABP

Transformer (B)
0.4 kV switchgear

AUTOMATED REVENUE METERING SYSTEM

Revenue metering process requires accuracy, efficiency and a certain degree of automation that makes it possible to use energy resources in a convenient way. To enhance the level of electric power consumption and metering control, an automated revenue metering system (ASCUE) has been developed on the bases of I&C TOPAZ.

FUNCTIONS OF THE REVENUE METERING SYSTEM

- Accurate and timely measurement of the amount of consumed/generated electric power;
- Automated collection of data on the volume of electric power consumption with a specified interval on the server;
- Real-time monitoring and real-time control of loads and emergency situations;
- Recording of breaches of the normal system operating mode in the event log for the analysis by the dispatch office and maintenance personnel;
- Analysis of the received data in accordance with the requirements of the Customer;
- Generation of reports on power flows and on the operation of measuring instruments
  (fault diagnosis) in line with the specified templates, storage of the report base;
- Storage of necessary data for a specified period of time in accordance with the Customer's requirements;
- Communication of data on electric power generation/consumption to the organizations concerned (NP ATS (WEM), energy utility, management company)

Actual commercial electricity consumption for any period of time (instantaneous consumption, consumption per hour, day, month, year, for the entire measured period)

Energy quality indicators
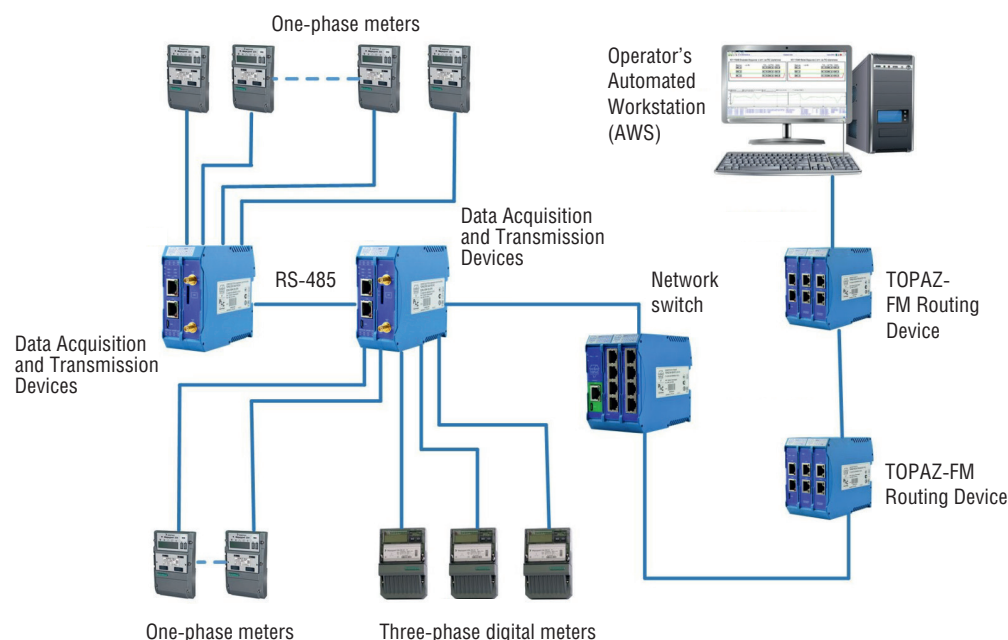
Technical condition of equipment

Technical condition of utility networks

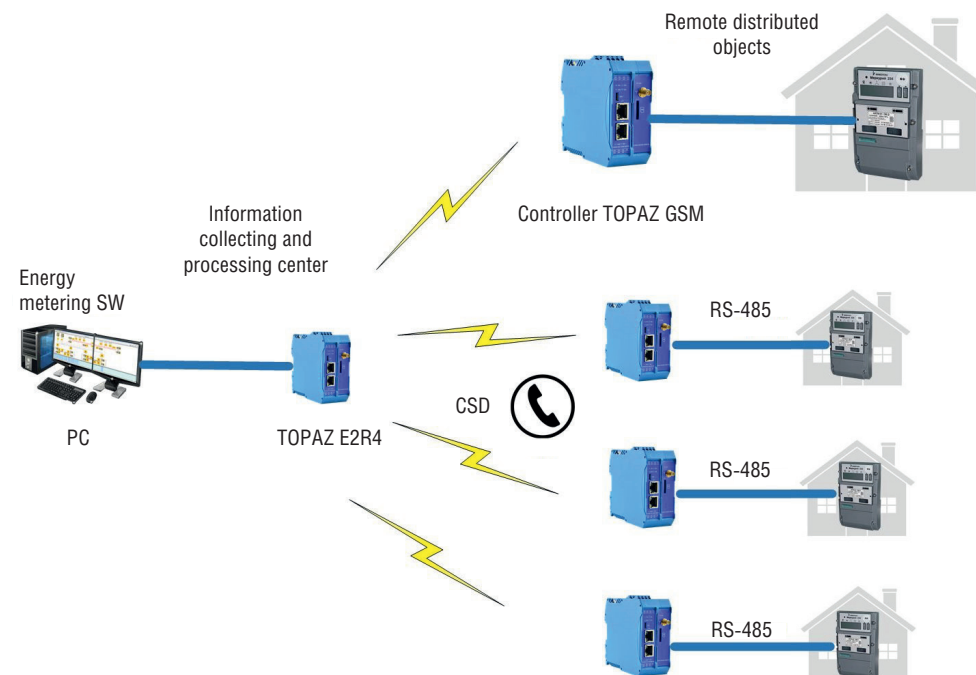Unauthorized access to metering devices

REMOTE CONTROL OF TRANSFORMER SUBSTATIONS

- reduction of power losses due to detecting cases of theft and quick identification of emergency situations;
- reduction of power consumption at the enterprise during peak hours of the power system due to operational control and limiting system;
- reduction of energy consumption by strengthening the user's discipline;
- reduction of energy consumption costs by switching to an optimal tariff rate and modifying the schedule of workshops and subdivisions in accordance with such tariff rate;
- exclusion of penalties for exceeding the committed capacity limits during maximum load hours of power system;
- reduction of the cost of electricity buying due to entering the wholesale market (WEM);
- optimization of labor costs through process automation;
- reduction of the number of unpaid invoices as it is possible to limit energy consumption quickly in a remote way;
- reduction of the time costs for technical and managerial solutions related to implementation of energy-saving measures.

FUNCTIONS OF THE REVENUE METERING SYSTEM

One-phase meters

Operator's Automated Workstation (AWS)

Data Acquisition and Transmission Devices

RS-485

Network switch

TOPAZ-FM Routing Device

Data Acquisition and Transmission Devices

TOPAZ-FM Routing Device

One-phase meters

Three-phase digital meters

AUTOMATED REVENUE METERING SYSTEM ASCUE OF GENERAL TYPE

Remote distributed objects

Information collecting and processing center

Controller TOPAZ GSM

Energy metering SW

RS-485

PC

TOPAZ E2R4

CSD

RS-485

RS-485

RS-485

ADCMS FOR INFRASTRUCTURE FACILITIES AND STRUCTURES
AUTOMATED DISPATCHING CONTROL AND MANAGEMENT SYSTEM

Subsystem for control of process parameters
of switchboards in state budgetary organization
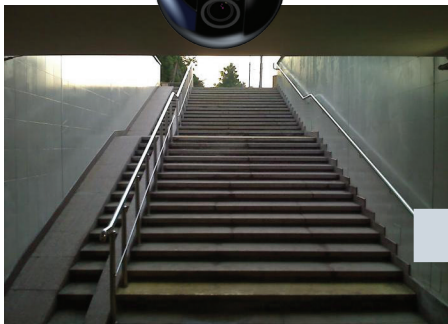«Gormost»

Dispatching center
Server telecommunication panel, remote control system
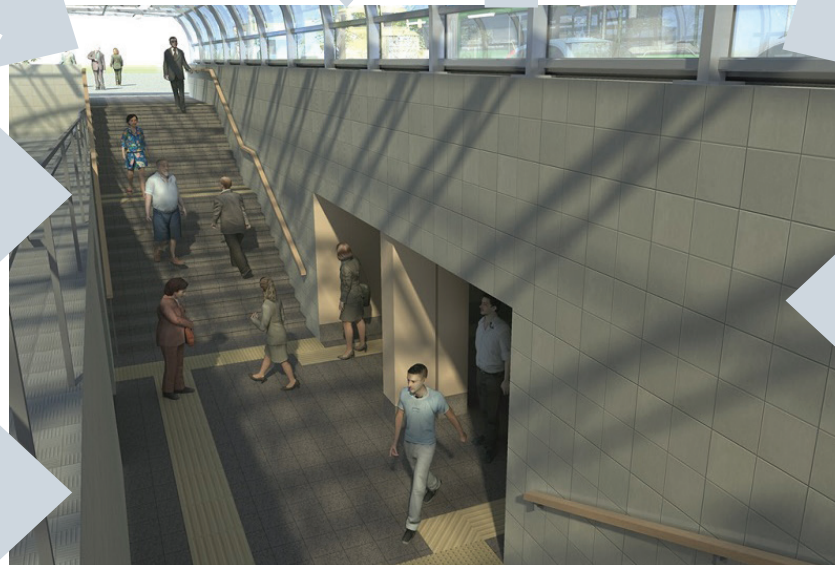workstation, CCTV workstation, video wall

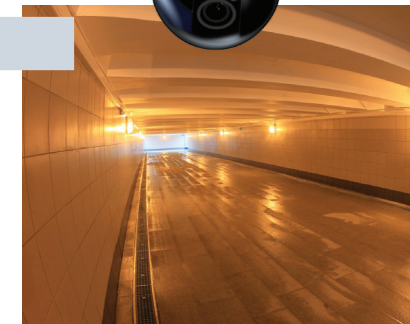Drainage installation control and management
subsystem

CCTV

CCTV

Access
control

Access control
and management system
Dispatching of snow removal system

Underground crossing
Subsystem for data collection and transmission

Remote lighting control

TOPAZ CABLE LINES TEMPERATURE CONTROL SYSTEM (TCS)

TOPAZ TCS is a stationary automated multi-channel system of continuous action intended for monitoring temperature distribution along cable lines. Temperature measurement is based on measuring optical Raman backscattering using optical reflectometry in the time domain.

MAIN TECHNICAL CHARACTERISTICS

Parameter name	Value
1	2
Operating mode	Continuous
Temperature measurement range, °C	minus 200 to plus 650
Temperature resolution, °C	0,1
Range of measurements in regard of cable length, km	15
Measurement step in regard of length, m	1.015... 1.030
Fiber type	multimode, 50/125
Laser wavelength, nm	1550
Nominal power supply voltage, V	24 (DC) or 220 (AC)
Maximum current consumption, mA, not over than	2,1 at 24DC, 0,3A at 220AC
Power consumption, W, no over than	50
Time of one measurement, s	3 at 4 km, 12 at 15 km
Time of settling of indications (output signal), s, from	15
Limit of permissible basic temperature measurement error, °C, not worse than: — during operation — after calibration	 ±0,5 ±0,1
Accuracy of determining the rupture point of the fiber optic cable, m, not more than	1
Overall dimensions (height x width x depth) mm	131x432x415
Weight, kg, not more than	10
Number of channels	1, 2, 4, 8 or 16
Degree of protection, not less than, when installed in a protective box	IP40 as per GOST 14254-96 IP67
Class of laser safety	1M as per GOST IEC 60825-1-2013
Class of protection against electric shock, not less than	II

KEY FEATURES OF THE HSS TOPAZ

Efficiency of implementation and operation due to unification
— Scalable unified software used at TOPAZ servers being the part of TCS as well as part of APCS.
— Scalable hardware – also used as part of TOPAZ TCS and as part of APCS.
— Unification of knowledge and skills of the operating personnel, standard solutions, software, devices, SPTA.
— Easy scalability, implementation of APCS automated algorithms on the basis of automatic processing of data from TOPAZ TCS
— Using only standard data exchange protocols in TOPAZ TCS
— Software is designed for working on different platforms
— MySQL DBMS with open source code is used as the data store
— Ability to exchange data with devices produced by different manufacturers.

Reliability of TOPAZ TCS due to the design based on standard instruments and components, commercially available, proven many times in other systems:
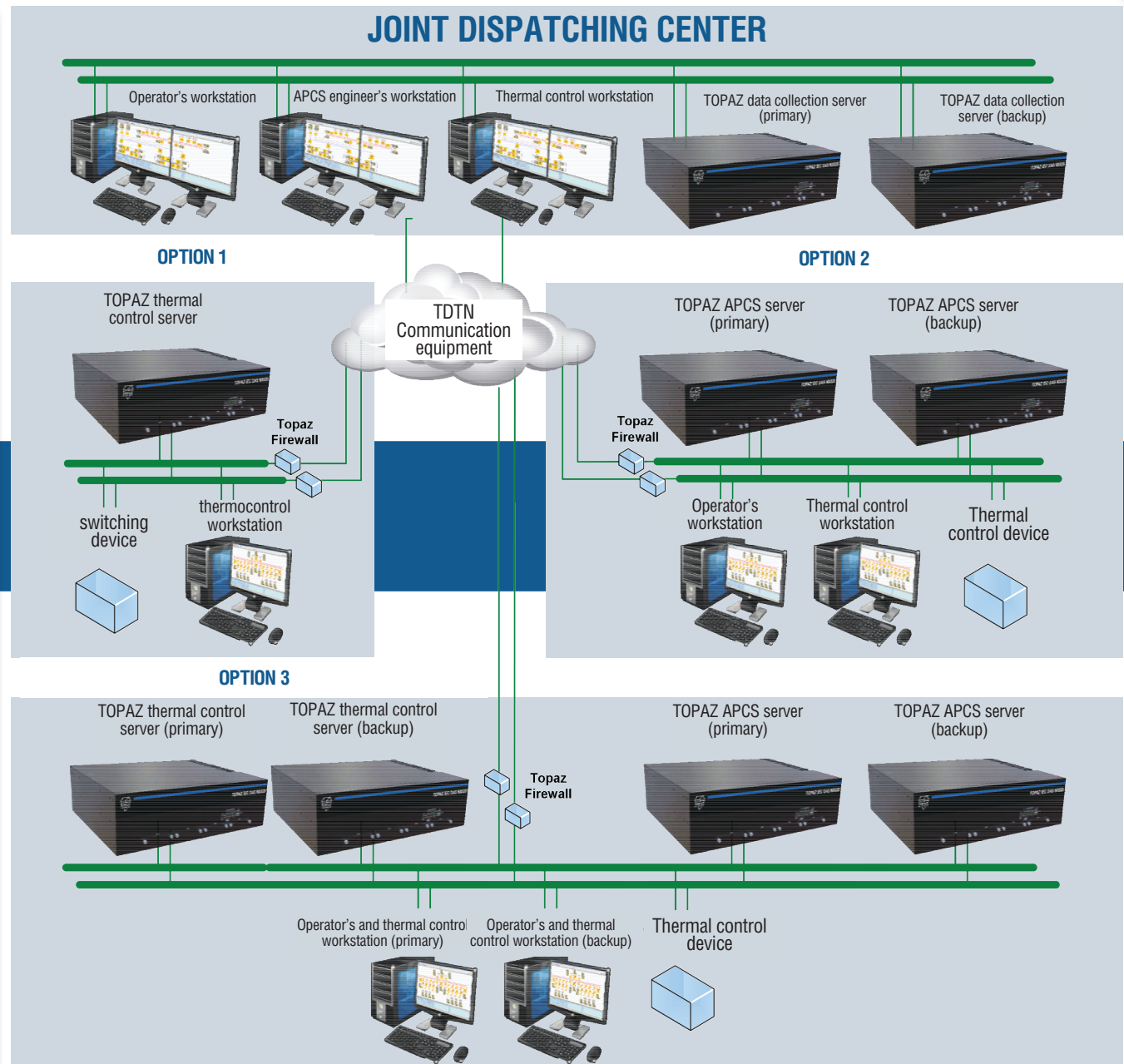— Use of fanless solutions for thermal control devices and for UPS system.
— Use of high-performance fanless industrial controllers as servers.
— Redundancy of servers and data exchange channels.

TOPAZ TCS HARDWARE PLATFORM

TOPAZ thermal control system allows to use either separate servers (Option 1,3), or substation APCS servers (Option 2) as hardware platform.

TOPAZ SCADA CLIENT software with TOPAZ thermal control extension is used in the client part; it may be installed and used either on separate workstations of TCS operators (Option 1,3) , or on the workstations of APCS operators (Option 2) , that is, full integration with APCS of the substation is implemented.

TOPAZ software and hardware complex, which includes TOPAZ thermal control system, allows to arrange a joint dispatching center (of telemechanics system, APCS and thermal control), including TOPAZ automated technological control system and supporting CIM model.

JOINT DISPATCHING CENTER

Operator's workstation | APCS engineer's workstation | Thermal control workstation | TOPAZ data collection server (primary) | TOPAZ data collection server (backup)

OPTION 1
TOPAZ thermal control server
switching device | thermocontrol workstation

TDTN Communication equipment

OPTION 2
TOPAZ APCS server (primary) | TOPAZ APCS server (backup)
Topaz Firewall
Operator's workstation | Thermal control workstation | Thermal control device

OPTION 3
TOPAZ thermal control server (primary) | TOPAZ thermal control server (backup) | TOPAZ APCS server (primary) | TOPAZ APCS server (backup)
Topaz Firewall
Operator's and thermal control workstation (primary) | Operator's and thermal control workstation (backup) | Thermal control device
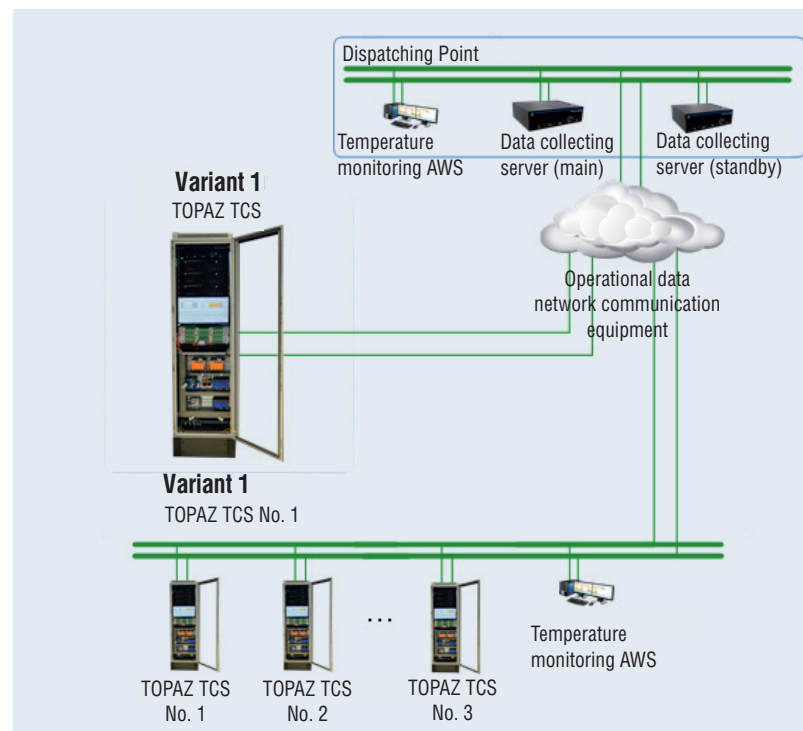
Topaz Firewall

FIBER OPTIC TEMPERATURE CONTROL SYSTEM OF DISTRIBUTED TYPE TOPAZ TCS

TOPAZ TCS is used for 110-500 kV cable lines monitoring (hereinafter referred to as CLs) via multi-mode or single-mode fiber optic cables which may be built into the power cable or laid separately. The TCS performs functions of measuring, recording, processing, displaying and transmitting data on the continuous temperature profile to higher level systems (CAPCS, DC, digital communication center etc.) along the entire length of the fiber optic cable and may be used both as a stand alone unit and as part of a centralized monitoring system of a power company.

The principle of the TCS operation in the course of the temperature measurement is based on the measurement of optical Raman back-scattered radiation in optical fibers and the use of an optical reflectometer in the time domain for distribution of measured values.

The TCS is equipped with all the necessary components for communication, as well as ensures collecting and transmitting the full scope of tele-data. The TCS is a fully ready-to-use product with an open, scalable and extensible architecture using solutions based on IEC standards and open data exchange protocols.

Dispatching Point

Temperature monitoring AWS

Data collecting server (main)

Data collecting server (standby)

Variant 1
TOPAZ TCS

Operational data network communication equipment

Variant 1
TOPAZ TCS No. 1

...

Temperature monitoring AWS

TOPAZ TCS No. 1

TOPAZ TCS No. 2

TOPAZ TCS No. 3

TCS MAIN ADVANTAGES:

Event detection (overheating, break, etc.) with geo-points for quick response

CL load forecasting function to ensure load balancing capability

Keeping a CL temperature profile archive to track long-term temperature anomalies

Designed for use on digital substations

TOPAZ SVAM VIBROACOUSTIC MONITORING SYSTEM

Vibroacoustic monitoring system is designed for timely detection of potentially dangerous actions referring to the secured object and transmission of information on the place and nature of the impact to a higher level system. It is installed on linear long-haul objects (CLs, overhead power lines, gas pipelines, oil pipelines, etc.) and perimeter-protected objects.
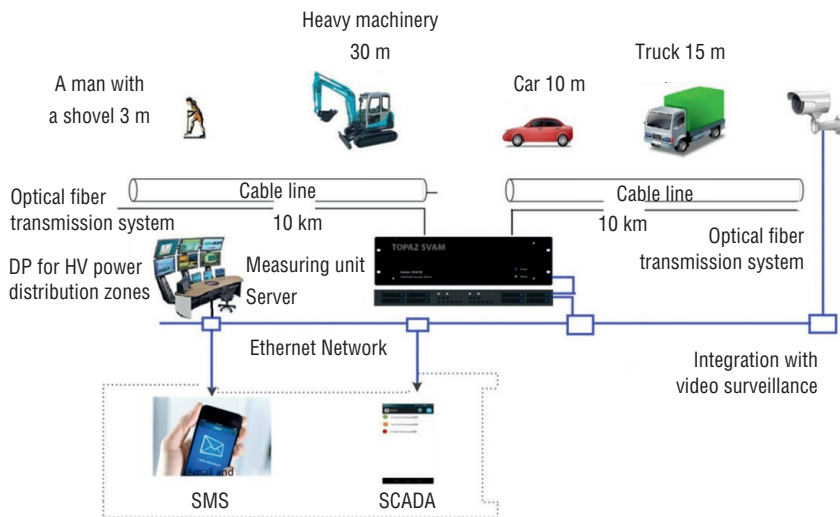
Typical SVAM scheme for CLs

Picture of AWS SW window

The SVAM records impacts at frequencies from 1 Hz to 2.5 kHz.

SVAM KEY ADVANTAGES:

- It may be used as a distributed fiber sensor based on already laid fiber optic cables.
- A ready-made library of events that makes it possible to put the equipment into operation as quickly as possible.
- Determination of event geo-points for quick response.
- Intelligent processing algorithms to minimize a number of false tripping.
- In case of installation on overhead power lines, it is possible to add an ice-melting thermal control system to SVAM as an option.
- Small size (3U) which makes it possible to place equipment in existing racks.
- Designed for use on digital substations

TOPAZ MPD partial discharge monitoring system

The TOPAZ MPD system is designed for continuous monitoring of the insulation condition of live cable lines. The system operates on a partial discharge (PD) pulse analysis inside the power cable insulation as well as the termination and connection sleeves.

The HF instrument is a device for analyzing and estimating the intensity and distribution of PD pulses. The measurement is taken with dedicated sensors, which are high-frequency current transformers installed on the ground conductor of the cable shield, in an open ground circuit, or the ground circuit of a capacitive sensor.

The AC instrument diagnoses PD and monitors the condition of the terminal and intermediate splice boxes of high-voltage cable lines.

Table 1. Technical data of the HF meter

Characteristic	Value
Number of PD recording channels	6
Operating voltage of controlled facilities	3 kV+
Frequency range of recorded pulses, MHz: • HF • UHF	0.1 20.0 400 1,500.0
Data transmission interface	Ethernet

Table 2. Technical data of the AC meter

Characteristic	Value
Number of recording channels	6
Operating voltage of controlled facilities	up to 500 kV
Discharge pulse frequency, kHz	30,300.0
Discharge value, pC	20 100,000
Communication interface	Ethernet

Technical data

• The operating temperature range of the system is −40 to +60 °C.
• Supply voltage, V:
• AC 90–260 V (50/60 Hz)
• DC 120–370 V

The technical specifications for the HF and AC instruments are given in Tables 1 and 2.

The system consists of two components:

TOPAZ HF partial discharge meter; TOPAZ AC partial discharge meter

TOPAZ SGS security alarm system

Product purpose

The system consists of two components:
- **TOPAZ SGS security alarm;**
- **alarm sensors in quantities to be determined by custom coding.**

The device is designed for use as part of security and alarm systems and provides:
- **monitoring and indication of the status of security and alarm optical sensors;**
- **an indication of the status of each alarm loop on the built-in indicators;**
- **alarm notification via alarm relay output contacts and/or digital communication channels.**

Digital interfaces
Up to 2 Ethernet interfaces and up to 3 RS-485 interfaces are envisaged.

TOPAZ SGS external design

Table 1. Working and operating conditions

Parameter name	Value
ambient air temperature, °C	between −40 and +70
relative humidity, non-condensing, %	100 (at 30 °C and lower temperatures)
atmospheric air pressure, kPa	between 60 and 106.7

Table 2. Characteristics of optical sensor connection channels

Parameter	Configuration
Number of the meter optical channels	up to 16
The optical cable maximum length to sensors	25 km

Table 4. Characteristics of ports and interfaces

Parameter name	Value
Ethernet communication interface	
Data exchange rate, Mbps	10 / 100
Supported protocols	IEC 60870-104, IEC 61850-8-1, PTP, PRP
RS-485 communication interfaces	
Data exchange rate	up to 115,200 bps
Supported protocols	IEC 60870-5-101

MICROPROCESSOR-BASED RELAY PROTECTION AND AUTOMATION DEVICES

CONSTRUCTION SPECIFICATION

The TOPAZ DRP protection, automation and control device is designed for use in electric grids. The device features a flexible configuration of software components and internal device logic, which allows the implementation of any set of protection, automation and control functions. The device series includes six specified standard configurations:

- Line protection, automation and control device.
- Input protection, automation and control device.
- Sectional circuit breaker protection, automation and control device.
- Voltage transformer cell protection, automation and control device.
- Static capacitor bank protection, automation and control device.
- Automatic frequency load shedding device.

Standard configurations can be user-programmed ones to modify the functions and solve specific non-typical tasks.

MAIN FUNCTIONS

1. Multistage overcurrent protection
   - Directed protection option
   - Acceleration option
   - Voltage-triggered actuation option
   - An increased current tolerance setpoint option.
2. Logical bus protection.
3. Protection against single-phase earth faults.
4. Arc fault protection.
5. Protection against asymmetric mode or phase failure.
6. Unbalance protection.
7. Monitoring the health of current and voltage circuits.
8. Automatic reclosure.
9. Breaker failure redundancy.
10. Automatic redundancy and restoration of the normal circuit.
11. Automatic frequency unloading.
12. Automatic undervoltage limitation.
13. Switch control automatics.
14. Remote protection.
15. Zero-sequence directional protection with a resistively grounded neutral.

General appearance

1. Fully user-definable device logic. Complete range of security and management tasks.
2. The logic is programmed using GUI block programming.
3. An extensive library of ready-to-use programming blocks.
4. Full support for IEC 61850 standard:
   - Configuration via SCL (IEC 61850-6).
   - Support for the MMS and GOOSE (IEC 61850-8-1) data sharing protocols.
5. PTPv2 and 1PPS time synchronization.
6. Support for IEC 60870-5-101/103/104 protocols.
7. Waveforms and event logs can be uploaded to a USB memory stick without connecting to a laptop.
8. Configuration files can be imported/exported via a USB stick without connecting to a laptop.
9. State-of-the-art hardware.
10. Temperature range between −40 °C and +55 °C.

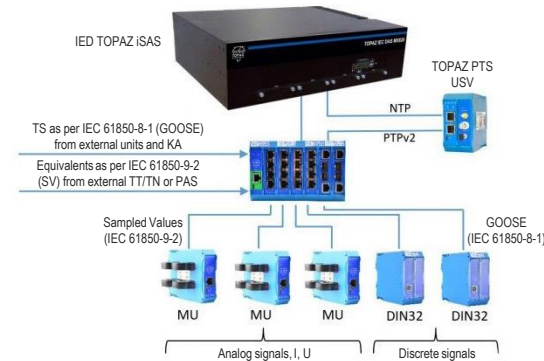# TOPAZ EER SOFTWARE/HARDWARE SELF-CONTAINED EMERGENCY EVENT RECORDER

The TOPAZ EER self-contained emergency event recorder is designed to record, process, store, and transfer analog and discrete pre-fault and fault mode waveform files in a power grid.

Sample deployment:

- The Biryulyovo 110 kV self-contained distribution substation
- Number of analog signals: 160
- Number of discrete signals: 64
- Layout: all the components are installed in the same two-way service cabinet

An example of a Biryulyovo 110 kV distribution substation cabinet layout is shown in Figure 6.

The TOPAZ EER emergency event recorder is a modular, highly configurable system that can be customized to meet the requirements of a specific project. TOPAZ EER is based on a digital substation principle. I.e. the logical elements of the system and the information links between them are made according to the IEC 61850 information model. The system is built around the TOPAZ iSAS intelligent electronic device (IED) (based on the TOPAZ IEC DAS MX xxx data access server and the dedicated TOPAZ EER software component. This configuration allows TOPAZ iSAS IED to record analog and discrete signals and enables automatic start on preset conditions (an external command or a specific parameter threshold value).

The software and hardware system includes equipment for interface with a TOPAZ MU process bus, which outputs the actual current and voltage values to the Ethernet network at fixed intervals in the Sampled Values format (IEC 61850-9-2). Discrete input modules TOPAZ DIN16/32C-Pr, capable of transmitting binary input states in GOOSE (IEC 61850-8-1), IEC 60870-5-101, IEC 60870-5-104 protocols are used for the input of binary signals.

A TOPAZ SW5xx managed network router forwards the Sampled Values as well as remote signals about the state of the discrete inputs transmitted via the Ethernet to the iSAS IED for further processing.

The TOPAZ EER includes a TOPAZ PTS time synchronizer to record precise time stamps with every analog or discrete event and to synchronize all components of the MU system via the PTPv2 protocol. TOPAZ PTS can also act as a precise time server for the SOEV computer control system of the substation. TOPAZ EER system components can be deployed both in a single cabinet and at various locations around a facility. For example, the TOPAZ MU analog signal converters and discrete input modules can be placed in indoor switchgear cells or the secondary substation commutation panels and cabinets. Also, digital measuring current and voltage transformers supporting the Sampled Values service (IEC 61850-9-2) can act as sources of analog signals.
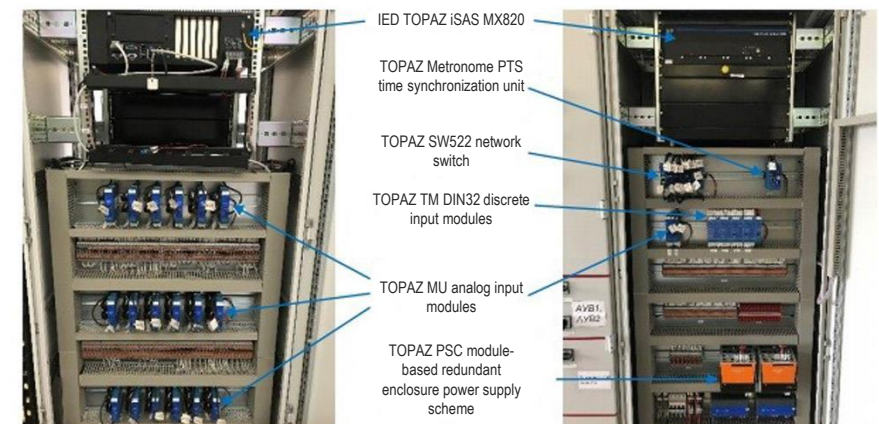
The sample layout of a 110 kV Biryulyovo automatic distribution substation

TOPAZ SM THREE-PHASE ELECTRIC POWER METER AND ELECTRIC POWER QUALITY INDICATOR METER

TOPAZ SM COMBINES THE FUNCTIONS OF AUTOMATIC COMMERCIAL POWER CONSUMPTION METERING, ELECTRIC POWER QUALITY CONTROL, AUTOMATED PROCESS CONTROL AND DIGITAL SUBSTATION SYSTEMS:

- **Electric power meter (commercial/technical metering);**
- **Electric power quality control unit;**
- **Instrument converter;**
- **Oscilloscope;**
- **Digital substation analog signal converter;**

Typical configurations can be changed by the user on the software level in order to change the functions and solve specific non-typical tasks.

Appearance

KEY FUNCTIONS

TOPAZ SM electric power meter is a modern high-precision electric power metering device and an electric power quality parameter and indicator meter that meets the requirements of Rosseti PJSC, has a wide range of communication capabilities and user services, can be used to implement the concepts of a Digital Substation, Digital RES, Smart Grid, and Smart Metering.

There is a version of the digital meter for a digital substation. This means, the meter has no analog inputs, only with 4 Eth, and all parameters are calculated based on the processing of incoming SV.

Its service life is 30 years.
Its time before failures is at least 150,000 hours.

Parameters	Values
Current input*	3 Inom 1 A or 5 A channels. Measuring range: 0.01 Inom to 2 Inom
Voltage input*	3 Unom 57.7 V or 220 V channels. Measurement range: 0.1 Unom to 2 Unom.
Number of Ethernet 100 Mb/s ports	Number of Ethernet 100 Mb/s ports Up to 4x Tx or Fx
Ethernet network redundancy protocols	RSTP, PRP
Time synchronization protocols	NTP/SNTP, IEEE 1588
Number of RS-485 ports	2
Data exchange protocols	IEC 61850-8-1 MMS and GOOSE, IEC 61850-9-2, electronic meter data exchange protocol specification, IEC 60870-5-104-2004, IEC 60870-5-101-2006, Modbus 2 galvanically isolated
Digital inputs	
Digital outputs	2 galvanically isolated
Power supply	Up to 2x 24 V DC or 220 V AC/DC ports

FUNCTIONS AND FEATURES

ELECTRIC POWER MEASUREMENT AND METERING

- Metering active and reactive power in the forward and reverse direction;
- Metering the power of the master frequency, direct sequence, energy and losses;
- Accuracy class for active energy: 0.2S;
- Accuracy class for reactive energy: 0.5;
- Metering all types of energy with 4 tariffs;
- 2 power profiles with configurable integration time for each type of energy;
- Supports the electronic meter data exchange protocol specification.

ELECTRIC POWER QUALITY CONTROL

- Electric power quality parameter measurements (more than 2,300 parameters and indicators) in accordance with: GOST 31819.22, GOST 31819.23, GOST 31818.11, GOST32144, GOST 30804.4.30 (class A), GOST 30804.4.7 (class I), GOST R 8.655, GOST 51317.4.15, GOST 33073;
- Complies with STO 56947007-29.200.80.180-2014 of FGC UES;
- Statistical data processing;
- Issuance of electric power quality control test reports in accordance with GOST 33073 in XLS and PDF formats.
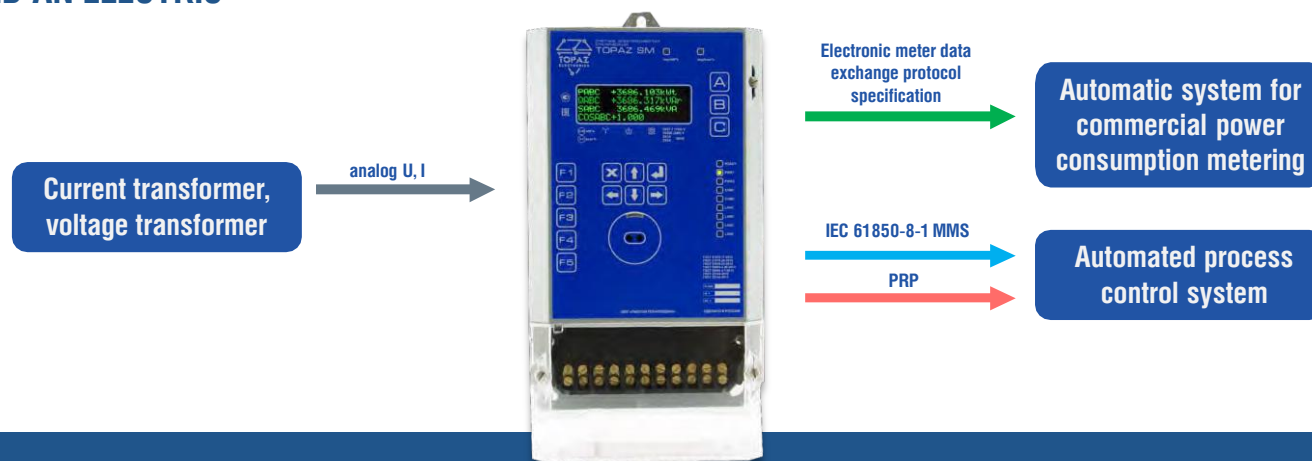
TELEMECHANICS

- High-precision grid parameter meter (I, U, P, Q, S, cosφ, f, U1,U2, U0, I1, I2, I0...);
- Measurement error: 0.2%;
- Waveform registration;
- Optional extension with digital I/O modules;
- Wide range of interfaces.

Analog signal converter (MERGING UNIT)

- Conversion of analog current AND voltage signals into a stream of instantaneous values Sampled Values in accordance with IEC 61850-9-2, IEC 61869-9;
- Supports IEEE 1588 (PTPv2) synchronization;
- Supports the following sampling frequencies: 80, 96, 256, 288 samples in 20 ms.
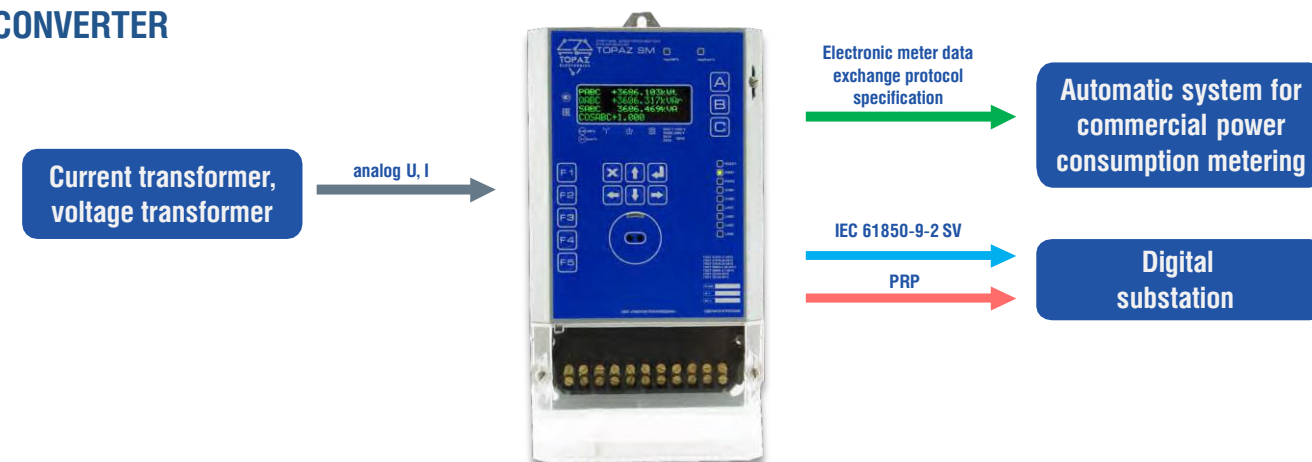
USE AS A CLASSICAL ELECTRIC POWER METER AND AN ELECTRIC POWER QUALITY CONTROL UNIT

The device is designed for use in classical electric power metering and quality control systems with integration into the automated process control system via the substation bus bar.

Current transformer, voltage transformer

analog U, I

Electronic meter data exchange protocol specification → **Automatic system for commercial power consumption metering**

IEC 61850-8-1 MMS
PRP → **Automated process control system**

USE AS A CLASSICAL ELECTRIC POWER METER AND AN ELECTRIC POWER QUALITY CONTROL UNIT AND AN ANALOG SIGNAL CONVERTER SIMULTANEOUSLY

In parallel with the main process for measurement, registration, and transmission of the measurement results to the upper levels of the automated systems, the device can perform the functions of an analog signal converter, i.e., it can publish instantaneous values of currents and voltages supplied to the analog inputs of the device in the form of a stream of Sampled Values, according to IEC 61850-9-2, to a network with parallel redundancy PRP.

Current transformer, voltage transformer

analog U, I

Electronic meter data exchange protocol specification → **Automatic system for commercial power consumption metering**

IEC 61850-9-2 SV
PRP → **Digital substation**

USE AS AN ELECTRIC POWER METER WITH INTEGRATION INTO AN AUTOMATED PROCESS CONTROL SYSTEM OR DIGITAL SUBSTATION UNDER THE PROTOCOL
IEC 61850-8-1

Subject to the corresponding model, the device can perform measurements (calculations) of a complete list of measured parameters based on the processing of the incoming SV flow(s) received from third-party analog signal converters or current transformers and voltage transformers with digital output. It then transmits the measurement results to the automatic system for commercial power consumption metering or to the automated process control system via the substation bus bars.

Current transformer, voltage transformer

IEC 61850-9-2 SV

PRP

Electronic meter data exchange protocol specification

Automatic system for commercial power consumption metering

IEC 61850-8-1 MMS

PRP

Automated process control system / digital substation

PLC
Technology
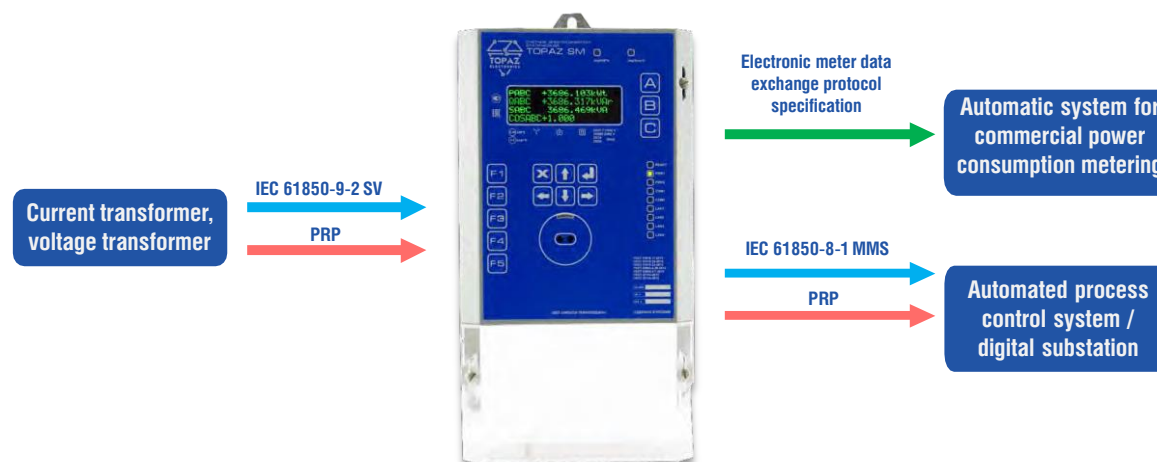
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Read the entire company
product catalogue